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Comprehensive Inventory of Birds and Mammals at Fort Necessity National Battlefield and Friendship Hill National Historic Site

Technical Report NPS/NERCHAL/NRTR-04/093

ON THE COVER
Golden-winged Warbler and Eastern Cottontail
Photographs by J. Kubel and B. Ross

Comprehensive Inventory of Birds and Mammals at Fort Necessity National Battlefield and Friendship Hill National Historic Site

Technical Report NPS/NERCHAL/NRTR-04/093

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Summary

National parks are becoming more insular due to increased habitat fragmentation in the surrounding landscape. These parks are becoming increasingly valuable for the long-term maintenance of faunal diversity (e.g., bird and mammal diversity) and the functional integrity of ecosystems. The National Park Service has determined the need for in-depth inventorying of bird and mammal populations at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) in southwestern Pennsylvania. The objectives of the bird and mammal inventory project were to (1) obtain comprehensive inventory data on birds and mammals, (2) document occurrence, identify distribution, and estimate relative abundance of birds and mammals, and (3) provide guidance for monitoring birds and mammals at FONE and FRHI.

We surveyed bird populations during the spring-migratory, breeding, fall-migratory, and winter seasons, September 2001 - July 2003, using point-count, vehicular-road, diurnal raptor and vulture, strip-transect, owl, and riparian-bird surveys. We detected 127 of 164 (77.4%) bird species that had been historically confirmed at FONE prior to our inventory, and three species not previously documented within the park. Twenty-one species of special concern occurred at FONE, including 14 species that possibly breed within the park. We detected 131 of 162 (80.8%) bird species that had been historically confirmed at FRHI prior to our inventory, and 11 species not previously documented within the park. Twenty-one species of special concern occurred at FRHI, including 11 species of special concern that possibly breed within the park. The species of special concern were highlighted by identification of the federally threatened and state endangered bald eagle (*Haliaeetus leucocephalus*) at FRHI during the winter and breeding seasons.

Additionally, we inventoried mammal populations during July - October of 2002 and 2003, using trapping and vehicular-road surveys. We detected all seven of the mammal species that had been historically confirmed at FONE prior to our inventory, and 18 species not previously documented within the park. We detected only 12 of 18 (66.7%) mammal species that had been historically confirmed at FRHI prior to our inventory. However, we found 6 species not previously documented at FRHI. The only mammal species of special concern recorded during the inventory, fisher (*Martes pennanti*), was identified at FONE in April of 2002.

Based on field-testing of survey protocols and conducting 2 years of inventories, we provided guidance for monitoring birds and mammals at the two parks. For monitoring birds, we recommend conducting point-count, vehicular-road, and diurnal raptor and vulture surveys during all seasons. To supplement this work, strip-transect surveys should be conducted during spring- and fall-migratory seasons and owl surveys should be conducted during the winter season. At FRHI, we recommend surveying riparian birds during winter and spring- and fall-migratory seasons. For monitoring mammals at FONE and FRHI, we recommend conducting trapping and vehicular-road surveys during late July or early August coupled with surveys during late September or early October. To increase the number of mammal species documented at the parks, a formal inventory of bat species should be conducted at each park.

By developing a monitoring program based on survey protocols and locations from our inventory project, resource management specialists can create an extensive long-term database of birds and mammals while adding to information already accumulated on presence, relative abundance, and distribution of species within each national park. Based on knowledge and information derived from this database, resource management specialists will be able to make informed decisions on how best to manage natural resources within the national parks.

Acknowledgments

The National Park Service provided funding for the bird and mammal inventory project. We appreciate cooperation of National Park Service personnel, especially Mr. John Karish, Regional Chief Scientist, The Pennsylvania State University and Ms. Connie Ranson, Resource Management Specialist, Fort Necessity National Battlefield and Friendship Hill National Historic Site. We extend our thanks to Mrs. Emily Hill for her clerical assistance.

Introduction

The National Park Service (NPS) determined the need for in-depth inventorying of birds and mammals at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI). Information is needed on species richness, abundance, and distribution of birds and mammals at these parks. Studies were conducted that identified and tested protocols for inventorying and monitoring bird and mammal populations in national parks (Yahner et al. 1997; Yahner et al. 1998). These previous studies along with the research project "Comprehensive Inventory Program for Birds at Six Pennsylvania National Parks" served as models for the bird and mammal work at FONE and FRHI. Thus, a major goal of the proposed study and of park personnel was to develop and initiate a comprehensive inventory of birds and mammals at FONE and FRHI. Information on presence, relative abundance, and distribution of birds and mammals on these public lands is important to NPS personnel who are mandated to manage natural resources (hereafter referred to as resource management specialists). As large tracts of public lands, such as national parks, become more insular from increased habitat fragmentation because of agricultural development, urbanization, or other land use, these lands will be increasingly valuable for the long-term maintenance of faunal diversity and the functional integrity of landscapes and ecosystems in the eastern United States (Ambrose and Bratton 1990; Yahner 1995).

Objectives

The objectives of the research project were to:

1. review existing literature and documentation of the National Park Service and other sources and develop a database for historic occurrence of birds and mammals at FONE and FRHI;

2. obtain a comprehensive inventory (based on 2 years) of birds and mammals at FONE and FRHI;

3. document occurrence, identify distribution, and estimate relative abundance of birds and mammals at FONE and FRHI; and

4. provide guidance for monitoring birds and mammals at FONE and FRHI in the future.

Study Areas

Fort Necessity National Battlefield

Fort Necessity National Battlefield (FONE) is located within the Laurel Highlands portion of the Allegheny Mountains in southwestern Pennsylvania approximately 17.5 km east of Uniontown (National Park Service 2001a) (Figure 1). The park encompasses approximately 370 ha in three separate units. The main portion of the park contains 350.5 ha and is made up of deciduous (209 ha) and coniferous (35 ha) forest and pasture/meadow (106.5 ha) (Paulson 1999). The main unit also contains numerous water sources, including three perennial streams and five ponds or impoundments, as well as man-made structures (e.g., Fort Necessity, the visitor center, and Mount Washington Tavern).

The Braddock Grave unit is approximately 2.5 km west of the main portion of the park and encompasses 9.5 ha. Deciduous forest (8.5 ha) within this section of the park contains a perennial stream. One ha of landscaped lawn surrounding the Braddock Grave is the only other cover type within this portion of the park.

The Jumonville Glen unit is approximately 11 km northwest of the main portion of the park and encompasses approximately 10 ha of deciduous forest. Topographic features include less than 0.4 ha area of rock outcroppings and one intermittent drainage stream.

Friendship Hill National Historic Site

Fort Necessity National Battlefield Friendship Hill National Historic Site (FRHI) is located within the Laurel Highlands of Fayette County, Pennsylvania, approximately 24 km south of Uniontown and 4.8 km north of Point Marion (National Park Service 2001b) (Figure 1). The park is comprised of 265 ha and borders the Monongahela River. FRHI contains 202.5 ha of deciduous and coniferous forest, 51.5 ha of abandoned drift mine, and 19 ha of mowed hayfields (Paulson 1999). The park contains rocky bluffs and a number of water sources, including four permanent streams, one pond, a 0.4-ha wetland, and numerous intermittent drainage streams.

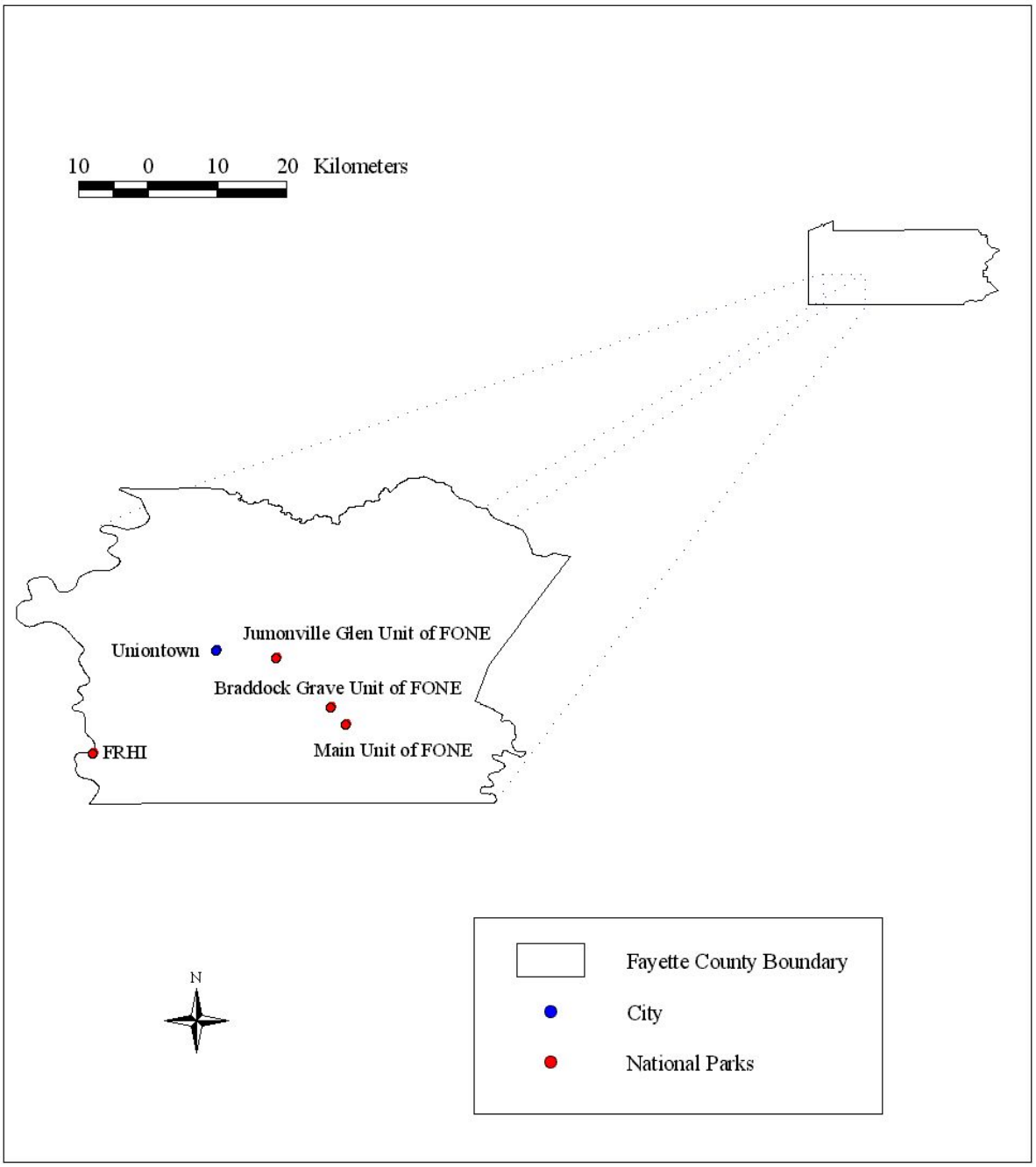

Figure 1. Location of two national parks in Pennsylvania used as study sites: Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI).

Methods

As a first step for the inventory, we developed a list of known and potential bird and mammal species at FONE and FRHI. The primary reference for this list was the NPSpecies database, which contains references to all species known to occur within the park boundaries. The NPSpecies database documents the occurrence of vertebrates and vascular plants in National Parks based on a variety of resources, such as published reports and museum records. Prior to querying the NPSpecies database, we searched reports and field notes at the parks, Breeding Bird Survey records, and the Pennsylvania Breeding Bird Atlas for species of birds and mammals known to occur in these parks (North American Breeding Bird Survey 2003; Brauning 1992). NPSpecies was then updated with our findings prior to October 2003 when we queried the database to create lists of potential bird and mammals for the two parks. After examining records of what species occurred historically in the parks and comparing the records with current findings of inventory projects, park managers can develop monitoring and management plans for these fauna.

To meet objective 2, we conducted surveys of birds and mammals for 2 years at FONE and FRHI. We selected protocols for inventorying birds and mammals based on taxonomic groups of interest, habitats, special needs, and infrastructure of each park. Bird protocols included fixed-distance and unlimited radius point-count, vehicular-road, diurnal raptor and vulture, and nocturnal-owl surveys (Yahner et al. 1998). In addition, researchers conducted riparian bird surveys at FRHI. Mammal protocols included trapping, vehicular-road, and surveys for signs of mammalian presence (Yahner et al. 1997).

During October and November 2000, researchers visited FONE and FRHI to view different sections and habitats within the parks and meet with resource management specialists to identify species and locations of concern within the parks. Prior to conducting the inventories, researchers developed the study plan titled “Comprehensive Inventory Program for Birds and Mammals at Fort Necessity National Battlefield and Friendship Hill National Historic Site” in consultation with John Karish, Regional Chief Scientist and Connie Ranson, Resource Management Specialist at FONE and FRHI. After the regional chief scientist and resource management specialist reviewed the study plan, meetings were held to discuss alterations and additions to the plan prior to conducting the inventories. All parties agreed upon a draft of the study plan that incorporated suggestions provided by the regional chief scientist and resource managers prior to initiating the research.

To some extent, park size and infrastructure and abundance and distribution of cover types within and surrounding the parks affect the type of surveys conducted and the number of sampling points and stations established for inventorying birds and mammals. For example, FRHI borders the Monongahela River, and FONE has no river systems within the park area. Thus, we conducted waterfowl surveys at FRHI but not at FONE. However, FONE consists of a larger total area than does FRHI, so we established a greater number of bird and mammal sampling points at FONE than at FRHI.

Geographic Analyses

We conducted geographic analyses to determine coarse-scale cover type, spatial location, elevation information, and potential sampling points for each park using Arc View version 3.0 software and ARC/Info geographic information system (Environmental Systems Research Institute, Inc., Redlands, CA, USA). All geographic coverages and associated documentation (i.e., metadata) are publicly available via the Pennsylvania Spatial Data Access World Wide Web server (www.pasda.psu.edu).

We obtained and used park boundaries to confine all subsequent geographic analyses to FONE and FRHI. Digital orthophoto quarterquads (DOQQs) with 1-m ground resolution were obtained from the Pennsylvania Spatial Data Access (PASDA) web site and used to extract land cover information for each park. Eight cover-type classifications were used to locate sampling points within the parks (Table 1).

Researchers obtained Pennsylvania Department of Transportation road and stream coverages from the PASDA website. All roads and blue-line streams appearing on 1:24,000 topographic maps were included in the coverages, and no distinctions were made based on road type or stream order. Buffers (50-m width) were constructed around roads and streams to identify areas that were spatially proximal to linear features of the landscape. The spatial locations of all areas were classified as interior (i.e., not contained within a buffer), road edge, stream edge, or road and stream edge overlap areas (Table 1). We eliminated road and stream edge overlap areas from further analysis.

We determined elevation from 2-arc-second (30 minute), United States Geological Survey (USGS) digital elevation models (DEM) with 100- x 100-m pixel resolution. We calculated total relief for each park based on DEMs. For parks with less than 100 m total relief (FRHI), no elevation categories were constructed. For parks with at least 100 m of total relief, areas lower than the mean elevation were designated as low elevation; areas higher than the mean elevation were designated as high elevation. FONE contains greater than 100 m relief and is divided into three distinct park units. Because of elevational differences among the separate park units, elevation categories for FONE were designated as: low (the main and Braddock Grave units 540 to 640 m) and high (the Jumonville Glen unit 650 to 720 m) (Table 1). For parks as small as FONE and FRHI, elevation may not be a factor influencing bird communities. However, this and other studies (Yahner et al. 2001) serve as models for designing future inventory and monitoring projects, so elevation was retained as a habitat category for selecting sampling points and trapping locations.

We integrated all data layers (cover type, spatial location, and elevation) to provide characterization of habitat distributions for each park. The area used for geographic analyses differs slightly from actual boundaries of parks because of differences in resolutions of the data layers used to generate the habitat information. The total area of all habitats for each park was used to allocate sampling points for the inventories.

Table 1. Description of cover types, spatial locations, and elevations used to define habitats at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) in Pennsylvania.

Habitat Category	Habitat	Description
Cover type		Cover types derived from Thematic Mapper classifications and used to categorize habitat at FONE and FRHI using digital orthophoto quarterquads
	Water	Areas dominated by water (e.g. emergent wetlands, streams, ponds)
	Coniferous forest	Forested areas dominated by coniferous-tree species
	Mixed forest	Forested areas dominated by a mixture of coniferous- and deciduous-tree species
	Deciduous forest	Forested areas dominated by deciduous-tree species
	Early successional	Areas dominated by old field, scrub/shrub, or heavily harvested habitats
	Perennial herbaceous	Areas dominated by perennial-herbaceous cover (e.g., pasture, lawn, grasslands)
	Annual herbaceous	Areas dominated by annual-herbaceous cover (e.g., cropland)
	Terrestrial unvegetated	Terrestrial areas dominated by lack of vegetation (e.g., urbanized land, roads, strip mines, bare ground)
Spatial location		Derived from Pennsylvania Department of Transportation digital road and stream coverage
	Interior	Areas > 50 m from a road or stream
	Road edge	Areas $\leq$ 50 m from a road
	Stream edge	Areas $\leq$ 50 m from a stream
Elevation		Derived from 100- x 100-m Digital Elevation Models (DEMs)
	Low	Areas $\leq$ median elevation for a park
	High	Areas > median elevation for a park

Sampling Point Identification

To identify potential sampling points for bird point-count surveys and mammal trapping locations, a systematic grid (150-m resolution) was generated for each park. The south and west bounding coordinates of each park boundary were used as the origin of the grid. Potential sampling points were placed at the centroids of each cell in the grid. Subsequently, the potential sampling points were characterized according to cover type, spatial location, and elevation. We stratified potential sampling points based on the three habitat categories to try and select randomly survey locations in proportion to habitat availability within each of the parks while attempting to visit as many habitats and detect as many species as possible.

Each park contains approximately one sampling point or trapping location for every 20 ha of park area. We distributed sampling points and trapping locations throughout each park using a stratified random design. The sampling points and trapping locations were selected based on three factors listed in order of importance: cover type (e.g., deciduous forest, perennial herbaceous), spatial location (interior, road edge, stream edge), and elevation (high or low) (Tables 2 and 3). Cover types comprising at least 15% of the total park area were divided into interior (> 50 m from edge) and edge (0-50 m from edge) spatial locations. If a cover type within a given spatial location (e.g., deciduous forest in an interior location) comprised at least 15% of the total park area, it was divided into elevations if applicable for the park. Cover types, cover types within a given spatial location, and cover types within a given spatial location and elevation (e.g., deciduous forest in an interior location at high elevation) that comprised less than 2.5% of the total park area did not receive any sampling points or trapping locations. We allocated numbers of sampling points and trapping locations proportional to the availability of each habitat. For example, if 50% of the total park area is located within deciduous forest in an interior location at high elevation, then 50% of the sample points for bird point-count surveys and mammal trapping locations were located within this habitat.

We allocated 23 bird point-count sampling points and 23 mammal trapping locations to FONE (Table 2). The main portion of FONE received 20 sampling points and 20 trapping locations, the Braddock Grave section received 1 sampling point and 1 trapping location, and the Jumonville Glen section received 2 sampling points and 2 trapping locations (Appendices A-E). We allocated 17 sampling points and 19 trapping locations to FRHI (Table 3 and Appendices F-H).

During initial visits to each park to discuss and develop the study plan with resource management specialists, we ground-truthed all sampling points and trapping locations to ensure the proper classification of each point according to geographic analyses of cover types and spatial locations. We relocated sampling points and trapping locations present within misclassified habitats. A limited number of sampling points and trapping locations (e.g., mammal trapping location and bird point-count sampling point numbers 5 at FONE and 7 at FRHI) were included in the bird and mammal surveys to address areas or species of special concern to resource managers within each park (e.g., vernal wetlands, areas proposed for management, etc.). Not all point-count sampling points for birds were incorporated into mammal trapping surveys due to the accessibility of the points to visitors and possible theft or damage to mammal traps. All sampling points at FONE and FRHI were located at least 150 m apart to avoid multiple counting of birds. We obtained universal transverse mercator (UTM)

Table 2. Allocation of sampling points for bird point-count surveys and trapping locations for mammal trapping surveys by cover type, spatial location, and elevation at Fort Necessity National Battlefield.

Cover Type	Spatial Location	Elevation	Number of Sampling Points or Trapping Locations
Mixed Forest	Interior	High	1
		Low	4
	Road Edge		1
	Stream Edge		1
Deciduous Forest	Interior	High	1
		Low	3
	Road Edge		1
	Stream Edge		1
Coniferous Forest	Interior		3
	Road Edge		1
	Stream Edge		1
Early Successional	Interior		2
	Stream Edge		1
Annual Herbaceous			1
Terrestrial Unvegetated			1
Totals			23

Table 3. Allocation of sampling points for bird point-count surveys and trapping locations for mammal trapping surveys by cover type and spatial location at Friendship Hill National Historic Site.

Cover Type	Spatial Location	Number of Sampling Points or Trapping Locations
Mixed Forest	Interior	6
	Road Edge	2
	Stream Edge	3
Early Successional	Interior	2
Perennial Herbaceous	Interior	2
Coniferous Forest	Interior	1
Terrestrial Unvegetated		1
Totals		17

coordinates for and mapped the location of each sampling point, trapping location, vehicular-road, diurnal raptor and vulture, owl, and riparian bird survey station, and strip-transect using ArcView computer software. The UTM coordinates were entered into a Trimble global positioning system (GPS). We used the GPS to identify the location of each sampling point, trapping location, vehicular-road, diurnal raptor and vulture, owl, and riparian bird survey station, and strip-transect within the parks prior to conducting the inventories.

Bird Surveys

Point-count Surveys

We surveyed birds from September 2001 through July 2003 at FONE and FRHI using fixed-distance and unlimited radius point-count survey protocols (International Bird Census Committee 1977; Fuller and Langslow 1984; Hutto et al. 1986; Verner and Ritter 1986; Buskirk and McDonald 1995; Dawson et al.1995; Savard and Hooper 1995). Birds were surveyed two times at each sampling point during each of four seasons: spring migratory (15 April-25 May), breeding (25 May-15 July), fall migratory (25 August-10 October), and winter (1 December-15 March) seasons. The two point-count surveys were spaced at regular intervals throughout each season. Each survey included 23 sampling points at FONE (Appendices B, D, and E) and 17 sampling points at FRHI (Appendix G). Point-count surveys were conducted in the morning (sunrise to 5 hours following sunrise) during spring migratory and breeding seasons, in the morning and evening (3 hours before sunset to sunset) during the fall migratory season, and throughout the day (30 minutes after sunrise to 30 minutes before sunset) during the winter season. Surveys were conducted on days with little or no precipitation and winds less than 25 kph. Prior to all point-count surveys, we recorded date, starting time, temperature (^{o}C), wind velocity (kph), cloud cover (%), precipitation, and depth (cm) of snow cover.

When conducting a point-count survey, the investigator stopped at a sampling point for a 1-minute equilibrium period. Following the equilibrium period, the investigator recorded the point number and the number and species of all birds seen or heard plus the horizontal distance to each bird for 10 minutes. Data were tabulated for the first 3 minutes, the first 5 minutes, and the total 10 minutes so they can be compared to data from studies that use these different lengths of time. Species richness and relative abundance (no./point) can be calculated at different fixed-distance radii for comparison to studies using different point-count survey distances.

Vehicular-road Surveys

We surveyed birds from September 2001 through July 2003 at FONE and FRHI using a vehicular-road survey protocol (Petraborg et al. 1953; Diem and Lu 1960; Hewitt 1967; Saunder et al. 1971; Yahner et al. 1998). Information derived from the vehicular-road surveys complements the information obtained from point-count surveys by helping to identify wide ranging and mobile species, such as ring-necked pheasant (*Phasianus colchicus*), ruffed grouse (*Bonasa umbellus*), and crows (*Corvus* spp.). Vehicular-road routes were designed for use on secondary roads and encompassed a variety of habitats represented within each park. The length of routes varied between parks depending upon park size and number of low-use secondary roads.

During visits to each park to develop the draft study plan, we determined the locations of the vehicular-road route and survey stations to ensure each route incorporated only secondary roads and stations encompassed the variability of habitats present within each park. Each survey included nine stations at FONE (Appendices B, D, and E) and five stations at FRHI (Appendix I).

Each vehicular-road survey station was surveyed two times during each of the four seasons: spring migratory, breeding, fall migratory, and winter. The two surveys were spaced at regular intervals throughout each season. Surveys were conducted in the morning during the spring migratory and breeding seasons, in the morning or evening during the fall migratory season, and throughout the day during the winter season. Surveys were conducted on days with little or no precipitation and winds less than 25 kph. Prior to each survey, we recorded starting time, temperature (^{o} C), wind velocity (kph), cloud cover (%), precipitation, and depth (cm) of snow cover.

When conducting a vehicular-road survey, the investigator stopped the engine and exited the vehicle at the first station and at 0.8-km (0.5 mile) intervals along the vehicular-road survey route (Robbins et al. 1986). Following a 1-minute equilibrium period, the investigator recorded station number and number and species of all birds seen or heard for 5 minutes. Data were tabulated for the first 3 minutes and for the total 5 minutes so they can be compared to data from studies that use either time duration. The number of observations of each bird species for each survey can be standardized (no./km) for comparative purposes.

Diurnal Raptor and Vulture Surveys

We surveyed raptors and vultures from September 2001 through July 2003 at FONE and FRHI using the diurnal raptor and vulture survey protocol (Yahner et al. 2001). Raptor and vulture survey routes included five stations at FONE (Appendices B, D, and E) and three stations at FRHI (Appendix I) with the stations being located along the vehicular-road survey routes (Appendices C-E and H). Diurnal raptor and vulture surveys were conducted two times per season, with the two surveys spaced at regular intervals throughout each season. Surveys were conducted during all seasons (spring migratory, breeding, fall migratory, and winter) between 1000 and 1500 hours EST on days with little or no precipitation and winds less than 25 kph (Grimm and Yahner 1985). Prior to each survey, we recorded starting time, temperature (^{o} C), wind velocity (kph), cloud cover (%), precipitation, and depth (cm) of snow cover.

During raptor and vulture surveys, we slowly drove the vehicular-road survey route with vehicle speed (typically 10 - 20 kph) depending on road type and traffic volume. At each station along the route, the investigators stopped the engine and exited the vehicle. Following a 1-minute equilibrium period, raptors and vultures were surveyed for 5 minutes. Number and species of raptors and vultures at and between stations were recorded. The number of each raptor and vulture species per station and survey can be standardized (no./hr) to compare the relative abundance of birds between stations and seasons (Grimm and Yahner 1985).

Strip-transect Surveys

We surveyed birds from September 2001 through May 2003 along forested edges at FONE and FRHI using the strip-transect technique (Conner and Dickson 1980). Information derived from the strip-transect surveys complements that obtained from point-count and vehicular-road surveys by increasing the likelihood of detecting migrating passerine species. We established 150- to 500-m transects at the junction of, and parallel to, forest/herbaceous or early succession edges. The number and length of transects depended on availability of suitable edges with an objective of having greater than 800 m total transect length at each park (Appendices B and G).

Birds were surveyed two times at each transect during spring and fall migratory seasons. The two strip-transect surveys were spaced at regular intervals throughout each season. Strip-transect surveys were conducted in the morning during spring and morning or evening during the fall on days with little or no precipitation and winds less than 25 kph. Date, starting time, temperature (^{o} C), wind velocity (kph), cloud cover (%), and precipitation were recorded prior to all transect surveys. When conducting a strip-transect survey, the investigator traveled along the edge interface at approximately 1 kph and recorded number and species of all birds, the horizontal distance the bird was from the edge, and the distance the investigator traveled along the transect.

Owl Surveys

We surveyed owls during the winter of 2001-02 and 2002-03 at FONE and FRHI using the nocturnal-owl survey protocol (Foster 1965; Lynch and Smith 1984; Morrell 1993). Nocturnal-owl surveys included five stations at FONE (Appendices B, D, and E) and three stations at FRHI (Appendix I) with the stations being located along the vehicular-road survey routes or in areas accessible during evening hours. Owl surveys were conducted two times during the winter season, with the two surveys spaced at least three weeks apart. Surveys were conducted no sooner than 1 hour after sunset and no later than 1 hour before sunrise on nights with little or no precipitation, winds less than 25 kph, and cloud cover less than 50%. Date, starting and ending times, temperature (^{o} C), wind velocity (kph), percent cloud cover (%), precipitation, and depth (cm) of snow cover were recorded prior to each survey.

At each station, we played calls of five owl species in the following order: saw-whet (*Aegolius acadicus*), eastern-screech (*Otus asio*), barred (*Strix varia*), long-eared (*Asio otus*), and great horned (*Bubo virginianus*) owl. Following a 1-minute equilibrium period, we played a call of saw-whet owl for 15 seconds. After 45 seconds of silence, we repeated two additional calling periods (call + 45 seconds of silence = calling period) and a fourth call by saw-whet owl followed by a 105 second silent period. We conducted this sequence (minus the equilibrium period) consecutively for each owl species at each station. We recorded number and species of owls identified during the equilibrium, calling, and silent periods.

Riparian Bird Surveys

We surveyed birds associated with riparian areas (e.g, waterfowl, waders, shorebirds, etc.) along the Monongahela River at FRHI from September 2001 through May 2003 using the riparian bird survey protocol (Yahner et al. 2001). The survey protocol followed the methods of Stott and

Olson (1972) and Thornburg (1973). Each survey included a visit to 3 stations located along the banks of the Monongahela River (Appendix I). Stations were established approximately 0.8 km (0.5 miles) apart along the riverbank at FRHI so that the entire portion of the Monongahela River bordering the park could be surveyed.

Surveys were conducted six times per year, two during fall (25 August-10 October), two during winter (1 December-15 March), and two during spring (15 April-25 May), with the two surveys during each season spaced at regular intervals. Surveys were conducted in the morning on days when visibility was not limited by precipitation. Date, starting and ending times, temperature (^{o}C), wind velocity (kph), cloud cover (%), and precipitation were recorded prior to each survey. The river and riverbank adjacent to each station were surveyed by using binoculars and a spotting scope. Number and species of riparian bird visually or vocally identified at each station were recorded.

Mammal Surveys

Trapping Surveys

We surveyed mammals from July 2002 through October 2003 at FONE and FRHI. Mammal trapping locations corresponded to the bird point-count sampling points and a point that bisected each bird strip-transect. Mammal trapping was conducted for 4-day and 3-day time periods during 2002 and two 3-day time periods during 2003 at each park. The time periods included 3 or 4 days during the last two weeks of July or first two weeks of August depending on the year and 3 days during the last two weeks in September or first two weeks in October. Initially, we used a 4-day trapping period, but to prevent over-stressing and possibly killing recaptured individuals, we converted to a 3-day trapping period. Mammal trapping surveys (survey = 24 hour time period) included 23 trapping locations at FONE (Appendices C-E) and 19 trapping locations at FRHI (Appendix H). We visited all locations at a park each morning during the 3- or 4-day trapping period.

We positioned three small live-traps (8 cm x 8 cm x 26 cm) 3 m east, south, and west and two small live-traps southeast and southwest of each trapping location during 2002 and 2003, respectively. We altered the survey protocol to include only two small live-traps per trapping location in 2003 because we rarely encountered small mammals in all three small traps during a 24-hour time period. Additionally, we placed a medium live-trap (13 cm x 13 cm x 41 cm) 3 m north of each trapping location. For one-third of the locations located in forest cover type, we placed the medium live-trap at the base of a tree to target flying squirrels (*Glaucomys* spp.). At each sample point that bisected the strip-transects, we positioned a large live-trap (26 cm x 32 cm x 81 cm) along the edge interface and approximately 20 m from the center of the trapping location. Each live trap was baited with peanut butter and oatmeal and contained bedding material for captured individuals. Using a stratified (according to habitat) sampling design, we selected randomly one-third of the trapping locations to include pitfall traps. Pitfall traps were placed in the center of selected trapping locations. Pitfall traps consisted of 5-gallon buckets sunk into the ground, leaving the rims flush with the surface. We consulted with cultural staff and received permission prior to installing the pitfall traps. We selected 5-gallon buckets because the buckets are large enough to provide microrefugia for captured species while

preventing individuals from escaping. Additionally, we selected pitfall traps without drift fences because previous research indicated higher capture rates for mammals in pitfall traps without drift fences versus pitfalls with drift fences (Yahner et al. 1997). Pitfall traps were installed at least 1 week prior to trapping to ensure minimal soil disturbance during the trapping period (Yahner et al. 1997). When the pitfall traps were set, their lids were propped up with clothespins to serve as a rain cover. The bucket was covered between trapping sessions. Each pitfall trap contained a sponge to prevent desiccation of amphibians captured accidentally and a cup with cotton to provide microhabitat refuges for mammals. The bucket was equipped with holes in order to allow water to drain from the bucket. Animals that died in the traps were left in the field and available to scavengers.

Date, starting and ending times, and weather conditions were recorded prior to each survey. Traps were checked each morning and first-time captures were toe-clipped in order to identify subsequently recaptured mammals. Number and species of mammals identified at each survey location were recorded.

Vehicular-road Surveys

We conducted mammal surveys using the vehicular-road survey routes established for birds at FONE and FRHI (Appendices C-E and H) (Yahner et al. 2001). We conducted two diurnal surveys and two nocturnal surveys during July-August and two diurnal and two nocturnal surveys during September-October of 2002 and 2003. The diurnal surveys were conducted between 15 minutes before sunrise and 2 hours after sunrise, while the nocturnal surveys were conducted between 2 hours before sunset and sunset. During mammal vehicular-road surveys, we slowly drove the survey route with vehicle speed (typically 10 - 20 kph) depending on road type and traffic volume. Unlike vehicular-road surveys for birds, the mammal vehicular-road surveys contained no stations and we recorded information on mammals during the entire duration of travel along the survey route. We recorded the number and species of all mammals identified, the horizontal distance of the mammal from the vehicular-survey route, and a description of the location of the mammal with respect to the survey route were recorded (after Yahner et al. 1997).

Mammal Sign

We documented any identifiable mammal sign (e.g., tracks, fecal samples, fur, etc.) encountered while conducting research within the parks. Detailed descriptions of location and type of sign were recorded.

Vegetation Measurements

We measured vegetation characteristics during July and August following methods of James and Shugart (1970), Best (1977), and Harvey and Finley (1995) at bird point-count sampling points and mammal-trapping locations. The objective of the vegetation surveys was to document microhabitat characteristics associated with each of the bird point-count sampling points and mammal trapping locations at the time of our inventory for possible use in comparison to future bird and mammal research. Although we did not summarize or analyze the vegetation data, the

information colleted during the vegetation surveys will be important for comparing and analyzing similarities and differences between future bird and mammal monitoring efforts to the data collected during this project. Vegetation measurements included density (no./ha) of overstory trees, understory trees, tall shrubs, and short shrubs; basal area (m^2/ha) of overstory trees; canopy cover (%); vegetation ground cover (%); and mean height (cm) of vegetation cover (Table 4).

Analyses

Data obtained from surveying birds and mammals at FONE and FRHI were summarized to provide information about species richness and relative abundance by park, season, survey method, cover type (forest cover type for birds at FONE), and residency or migratory status for birds. We present the relative abundance of bird species for each park by season for long- and short-distance migrants and permanent residents. We defined long distance migrants as bird species that reside outside of the continental United States and Canada during part of the year. Short-distance migrants are birds that migrate to other parts of the continental United States and Canada during part of the year. Permanent residents are bird species that are present at the parks year-round. Relative abundance is defined as the number of individual birds by species within a 75 m radius of the observer averaged over surveys (2 surveys), years (2 years), and all 17 bird point-count sampling points at FRHI and 12 sampling points within forest cover type at FONE. In conjunction with the relative abundance, we present the variability (standard deviation) between sampling points for the average number of individual birds by species over surveys and years. All sampling points were used for analysis at FRHI due to the small number of sampling points being located within a single cover type. However, a large enough number of the sampling points at FONE were located within interior forest areas to present relative abundance of birds associated with forest cover. No formal detection probability estimation analyses were conducted when presenting the relative abundance of bird species. However, delectability of bird species was considered when designing the research project and the analyses. We conducted bird point-count surveys during all seasons and different times of the day depending on the season to maximize the probability of identifying all bird species (e.g., early morning during the breeding season to detect vocalizing males, and more than one hour after sunrise in the winter when foraging flocks become more active). Additionally, we conducted surveys only during periods of good weather (no precipitation and low wind) and for an extended time period (10 minutes) in order to maximize the probability of detecting all species and individuals at a sampling point. When calculating relative abundance of bird species, we included only birds within 75 m of the bird point-count sampling point to avoid differential detection of many bird species outside 75 m. We classified the relative abundance of bird species by season at the two parks (appendices K and P) to help natural resource professionals update the pamphlets (created in the early 1980's) and other outreach materials that FONE and FRHI provide to park visitors.

Relative abundance of small and some medium-sized mammals (those captured) was calculated as the number of individual mammals by species averaged over surveys (each 24-hour time period), years (2 years), and survey locations (for trapping surveys). All sampling points were used in the calculation of relative abundance of mammals identified during trapping due to the small number of pitfall and large cage traps used in certain cover types. Relative abundance of some small to medium sized mammals (eastern chipmunk, squirrels, woodchuck) and larger

Table 4. Vegetation characteristics (and survey methods) measured at bird point-count sampling points and mammal trapping locations at Fort Necessity National Battlefield and Friendship Hill National Historic Site.

Vegetation Characteristic	Method
Overstory:	
Overstory Tree Density (no./ha)	Number of trees $\geq$ 1.5 m tall and > 7.5 cm diameter at breast height (dbh) (1.37 m) by species in a 11.4 m radius plot centered on each sampling point.
Overstory Basal Area (m^2/ha)	Basal area of overstory trees by species in a 11.4 m radius plot centered on each sampling point.
Understory:	
Understory Tree Density (no./ha)	Number of trees $\geq$ 1.5 m tall and 2.5 cm to 7.5 cm dbh by species along 1 x 22.8 m north-south and east-west azimuths that intersect at the plot center.
Tall Shrub Density (no./ha)	Number of shrubs $\geq$ 1.5 m tall and < 2.5 cm dbh by species along 1 x 22.8 m north-south and east-west azimuths that intersect at the plot center.
Short Shrub Density (no./ha)	Number of shrubs < 1.5 m tall and < 2.5 cm dbh by species along 1 x 22.8 m north-south and east-west azimuths that intersect at the plot center.
Cover:	
Canopy Cover (%)	Number of the 20 points located at 2-m intervals along north-south (n = 10) and east-west (n = 10) azimuths that the cross hairs of an ocular tube intercept overstory or understory tree vegetation.
Vegetative Ground Cover (%)	Number of the 20 points located at 2-m intervals along north-south (n = 10) and east-west (n = 10) azimuths that the cross hairs of an ocular tube intercept vegetative ground cover.
Overstory:	
Herbaceous Vegetative Height (cm)	Height of herbaceous vegetation located 2 m from the center point along north-south (n = 2) and east-west (n = 2) azimuths.

mammals (white-tailed deer, bear) was defined as the number of individual mammals by species averaged over years, survey periods, time of day (morning and evening), and surveys for vehicular-road surveys. The relative abundance of mammals was presented separately for trapping and vehicular-road surveys because vehicular-road surveys were designed to detect medium to large mammal species not targeted by trapping.

This information is valuable to resource management specialists as a baseline, comprehensive inventory of birds and mammals for the parks. To meet objective four, we used this information to provide guidance to natural resource professionals when monitoring birds and mammals at the parks. Our assessments and recommendations are presented in the Discussion and Developing a Monitoring Program sections of the report.

Results

Birds

We detected a total of 157 bird species at FONE and FRHI combined from September 2001 - July 2003 (Table 5). Several species of special concern used the parks at different times of the year (Table 6). We detected 26 species of special concern at the two parks combined, including 16 species located at both parks. Most notably, 15 species of special concern potentially bred in at least one of the parks.

Fort Necessity National Battlefield

All Seasons Combined: We identified 130 bird species at FONE from September 2001 - July 2003 using point-count, vehicular-road, diurnal raptor and vulture, strip-transect, and owl surveys (Table 5). We detected 127 of 164 (77.4%) bird species that had been historically confirmed at FONE prior to our inventory (National Park Service 2003). Additionally, we detected three species not previously documented within the park, including black vulture, least sandpiper, and northern saw-whet owl (scientific names are given in Table 5). A majority of the species previously documented at FONE but not recorded in our inventory included grassland associates (northern harrier, American kestrel, ring-necked pheasant, eastern kingbird, horned lark, Henslow's sparrow, savannah sparrow, and bobolink), wetland associates (osprey, purple martin, bank swallow, cliff swallow, northern rough-winged swallow, marsh wren, and sedge wren), neotropical migratory transients (tundra swan, olive-sided flycatcher, Philadelphia vireo, veery, gray-cheeked thrush, mourning warbler, Connecticut warbler, northern waterthrush, and summer tanager), and transient, winter residents (American pipit, rusty blackbird, red crossbill, white-winged crossbill, and pine siskin).

Twenty-one species of special concern were detected at FONE, including four state vulnerable species (northern goshawk, northern saw-whet owl, yellow-bellied flycatcher, Swainson's thrush) (Table 6). Most (n = 16) species of special concern were found in the park during spring migration. We found 14 species of special concern that possibly breed within the park, including northern goshawk, American woodcock, black-billed cuckoo, northern saw-whet owl, Acadian flycatcher, willow flycatcher, wood thrush, blue-winged warbler, golden-winged warbler, cerulean warbler, prairie warbler, Kentucky warbler, Louisiana waterthrush, and grasshopper sparrow.

Spring Migration: We found the highest number of bird species at FONE during the 2002-03 spring-migratory seasons (n = 113) (Appendix J). Based on all bird survey protocols combined for spring migration, seven species (red-eyed vireo, American crow, black-capped chickadee, black-throated green warbler, eastern towhee, field sparrow, American goldfinch) were categorized as abundant (i.e., located in large numbers and in more than one habitat). Of the 12 species categorized as common (i.e., located in fairly large numbers in appropriate habitat), seven were permanent residents. The highest number of bird species (n = 52) was categorized as occasional (i.e., present in some parcels of appropriate habitat, but not certain to be detected), including 23 long-distance migrants.

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Double-crested cormorant (*Phalacrocorax auritus*) [b]				X
Green heron (*Butorides virescens*)	X	X	X	
Great blue heron (*Ardea herodias*)	X	X	X	X
Tundra swan (*Cygnus columbianus*)	X		X	
Canada goose (*Branta canadensis*)	X	X	X	X
Wood duck (*Aix sponsa*)			X	X
Mallard (*Anas platyrhynchos*)	X	X	X	X
American black duck (*Anas rubripes*) [b]			X	X
Canvasback (*Aythya valisineria*) [b]				X
Hooded merganser (*Lophodytes cucullatus*) [b]				X
Turkey vulture (*Cathartes aura*)	X	X	X	X
Black vulture (*Coragyps atratus*)		X		X
Osprey (*Pandion haliaetus*)	X		X	X
Northern harrier (*Circus cyaneus*)	X		X	
Bald eagle (*Haliaeetus leucocephalus*)				X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Sharp-shinned hawk (*Accipiter striatus*)	X	X	X	X
Cooper's hawk (*Accipiter cooperii*)	X		X	X
Northern goshawk (*Accipiter gentilis*)	X	X	X	
Broad-winged hawk (*Buteo platypterus*)	X	X	X	X
Red-shouldered hawk (*Buteo lineatus*)	X	X	X	X
Red-tailed hawk (*Buteo jamaicensis*)	X	X	X	X
American kestrel (*Falco sparverius*)	X		X	X
Ring-necked pheasant (*Phasianus colchicus*)	X		X	
Wild turkey (*Meleagris gallopavo*)	X	X	X	X
Ruffed grouse (*Bonasa umbellus*)	X	X	X	
Northern bobwhite (*Colinus virginianus*)				X
Killdeer (*Charadrius vociferus*)	X	X	X	X
Spotted sandpiper (*Actitis macularia*)				X
Least sandpiper (*Calidris minutilla*)		X		
American woodcock (*Scolopax minor*)	X	X	X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Rock dove (*Columba livia*)	X		X	X
Mourning dove (*Zenaida macroura*)	X	X	X	X
Yellow-billed cuckoo (*Coccyzus americanus*)	X	X	X	X
Black-billed cuckoo (*Coccyzus erythropthalmus*)	X	X	X	X
Great horned owl (*Bubo virginianus*)	X	X	X	X
Barred owl (*Strix varia*)	X	X	X	X
Eastern screech-owl (*Otus asio*)	X	X	X	X
Northern saw-whet owl (*Aegolius acadicus*)		X		
Common nighthawk (*Chordeiles minor*)	X		X	X
Whip-poor-will (*Caprimulgus vociferus*)	X		X	
Chimney swift (*Chaetura pelagica*)	X	X	X	X
Ruby-throated hummingbird (*Archilochus colubris*)	X	X	X	X
Belted kingfisher (*Ceryle alcyon*)	X	X	X	X
Red-headed woodpecker (*Melanerpes erythrocephalus*)	X		X	
Red-bellied woodpecker (*Melanerpes carolinus*)	X	X	X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Northern flicker (*Colaptes auratus*)	X	X	X	X
Yellow-bellied sapsucker (*Sphyrapicus varius*)	X	X	X	X
Downy woodpecker (*Picoides pubescens*)	X	X	X	X
Hairy woodpecker (*Picoides villosus*)	X	X	X	X
Pileated woodpecker (*Dryocopus pileatus*)	X	X	X	X
Olive-sided flycatcher (*Contopus cooperi*)	X		X	
Eastern wood-pewee (*Contopus virens*)	X	X	X	X
Acadian flycatcher (*Empidonax virescens*)	X	X	X	X
Yellow-bellied flycatcher (*Empidonax flaviventris*)	X	X	X	
Alder flycatcher (*Empidonax alnorum*)	X	X	X	
Willow flycatcher (*Empidonax traillii*)	X	X	X	
Least flycatcher (*Empidonax minimus*)	X	X	X	X
Eastern phoebe (*Sayornis phoebe*)	X	X	X	X
Great crested flycatcher (*Myiarchus crinitus*)	X	X	X	X
Eastern kingbird (*Tyrannus tyrannus*)	X		X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
White-eyed vireo (*Vireo griseus*)	X	X	X	X
Yellow-throated vireo (*Vireo flavifrons*)	X	X	X	X
Blue-headed vireo (*Vireo solitarius*)	X	X	X	X
Red-eyed vireo (*Vireo olivaceus*)	X	X	X	X
Philadelphia vireo (*Vireo philadelphicus*)	X		X	X
Warbling vireo (*Vireo gilvus*)	X	X	X	X
Blue jay (*Cyanocitta cristata*)	X	X	X	X
American crow (*Corvus brachyrhynchos*)	X	X	X	X
Fish crow (*Corvus ossifragus*)				X
Common raven (*Corvus corax*)	X	X	X	X
Horned lark (*Eremophila alpestris*)	X		X	
Tree swallow (*Tachycineta bicolor*)	X	X	X	X
Purple martin (*Progne subis*)	X		X	
Bank swallow (*Riparia riparia*)	X		X	
Cliff swallow (*Petrochelidon pyrrhonota*)	X		X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Northern rough-winged swallow (*Stelgidopteryx serripennis*)	X		X	X
Barn swallow (*Hirundo rustica*)	X	X	X	X
Tufted titmouse (*Baeolophus bicolor*)	X	X	X	X
Black-capped chickadee (*Poecile atricapilla*)	X	X	X	X
Carolina chickadee (*Poecile carolinensis*)	X	X	X	X
Brown creeper (*Certhia americana*)	X	X	X	X
White-breasted nuthatch (*Sitta carolinensis*)	X	X	X	X
Red-breasted nuthatch (*Sitta canadensis*)	X	X	X	X
House wren (*Troglodytes aedon*)	X	X	X	X
Winter wren (*Troglodytes troglodytes*)	X	X	X	
Carolina wren (*Thyothorus ludovicianus*)	X	X	X	X
Marsh wren (*Cistothorus palustris*)	X		X	
Sedge wren (*Cistothorus platensis*)	X		X	
Golden-crowned kinglet (*Regulus satrapa*)	X	X	X	X
Ruby-crowned kinglet (*Regulus calendula*)	X	X	X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Blue-gray gnatcatcher (*Polioptila caerulea*)	X	X	X	X
Eastern bluebird (*Sialia sialis*)	X	X	X	X
Wood thrush (*Hylocichla mustelina*)	X	X	X	X
Veery (*Catharus fuscescens*)	X		X	X
Gray-cheeked thrush (*Catharus minimus*)	X			X
Swainson's thrush (*Catharus ustulatus*)	X	X	X	X
Hermit thrush (*Catharus guttatus*)	X	X	X	X
American robin (*Turdus migratorius*)	X	X	X	X
Gray catbird (*Dumetella carolinensis*)	X	X	X	X
Northern mockingbird (*Mimus polyglottos*)	X	X	X	X
Brown thrasher (*Toxostoma rufum*)	X	X	X	X
European starling (*Sturnus vulgaris*)	X	X	X	X
American pipit (*Anthrus rubescens*)	X		X	
Cedar waxwing (*Bombycilla cedrorum*)	X	X	X	X
Blue-winged warbler (*Vermivora pinus*)	X	X	X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Golden-winged warbler (*Vermivora chrysoptera*)	X	X	X	
Tennessee warbler (*Vermivora peregrina*)	X	X		X
Orange-crowned warbler (*Vermivora celata*)	X		X	
Nashville warbler (*Vermivora ruficapilla*)	X	X	X	X
Northern parula (*Parula americana*)	X	X	X	X
Chestnut-sided warbler (*Dendroica pensylvanica*)	X	X	X	X
Cape May warbler (*Dendroica tigrina*)	X	X	X	X
Magnolia warbler (*Dendroica magnolia*)	X	X	X	X
Yellow-rumped warbler (*Dendroic coronata*)	X	X	X	X
Black-and-white warbler (*Mniotilta varia*)	X	X	X	X
Black-throated blue warbler (*Dendroica caerulescens*)	X	X	X	
Cerulean warbler (*Dendroica cerulea*)	X	X	X	X
Blackburnian warbler (*Dendroica fusca*)	X	X	X	X
Black-throated green warbler (*Dendroica virens*)	X	X	X	X
Yellow-throated warbler (*Dendroica dominica*)	X	X	X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Prairie warbler (*Dendroica discolor*)	X	X	X	X
Bay-breasted warbler (*Dendroica castanea*)	X	X	X	X
Blackpoll warbler (*Dendroica striata*)	X	X	X	X
Pine warbler (*Dendroica pinus*)	X	X	X	X
Palm warbler (*Dendroica palmarum*)	X	X	X	X
Yellow warbler (*Dendroica petechia*)	X	X	X	X
Mourning warbler (*Oporornis philadelphia*)	X		X	X
Connecticut warbler (*Orporornus agilis*)	X		X	
Kentucky warbler (*Oporornis formosus*)	X	X	X	X
Canada warbler (*Wilsonia canadensis*)	X	X	X	X
Wilson's warbler (*Wilsonia pusilla*)	X	X	X	X
Hooded warbler (*Wilsonia citrina*)	X	X	X	X
Worm-eating warbler (*Helmitheros vermivorus*)	X	X	X	X
Ovenbird (*Seiurus aurocapillus*)	X	X	X	X
Louisiana waterthrush (*Seiurus motacilla*)	X	X	X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Northern waterthrush (*Seiurus noveboracensis*)	X		X	X
Common yellowthroat (*Geothlypis trichas*)	X	X	X	X
Yellow-breasted chat (*Icteria virens*)	X	X	X	X
American redstart (*Setophaga ruticilla*)	X	X	X	X
Summer tanager (*Piranga rubra*)	X		X	X
Scarlet tanager (*Piranga olivacea*)	X	X	X	X
Eastern towhee (*Pipilo erythrophthalmus*)	X	X	X	X
American tree sparrow (*Spizella arborea*)	X	X	X	X
Field sparrow (*Spizella pusilla*)	X	X	X	X
Chipping sparrow (*Spizella passerina*)	X	X	X	X
Grasshopper sparrow (*Ammodramus savannarum*)	X	X		X
Henslow's sparrow (*Ammodramus henslowii*)	X			
Fox sparrow (*Passerella iliaca*)	X	X	X	
Savannah sparrow (*Passerculus sandwichensis*)	X		X	
Lincoln's sparrow (*Melospiza lincolnii*)	X	X	X	

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Song sparrow (*Melospiza melodia*)	X	X	X	X
Vesper sparrow (*Pooecetes gramineus*)	X	X	X	X
Swamp sparrow (M*elospiza georgiana*)	X	X	X	X
White-throated sparrow (*Zonotrichia albicollis*)	X	X	X	X
White-crowned sparrow (*Zonotrichia leucophrys*)	X		X	X
Dark-eyed junco (*Junco hyemalis*)	X	X	X	X
Rose-breasted grosbeak (*Pheucticus ludovicianus*)	X	X	X	X
Northern cardinal (*Cardinalis cardinalis*)	X	X	X	X
Indigo bunting (*Passerina cyanea*)	X	X	X	X
Bobolink (*Dolichonyx oryzivorus*)	X		X	X
Eastern meadowlark (*Sturnella magna*)	X	X	X	X
Red-winged blackbird (*Agelaius phoeniceus*)	X	X	X	X
Common grackle (*Quiscalus quiscula*)	X	X	X	X
Rusty blackbird (*Euphagus carolinus*)	X		X	
Brown-headed cowbird (*Molothrus ater*)	X	X	X	X

Table 5. Bird species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Orchard oriole (*Icterus spurius*)	X		X	X
Baltimore oriole (*Icterus galbula*)	X	X	X	X
Purple finch (*Carpodacus purpureus*)	X	X	X	X
House finch (*Carpodacus mexicanus*)	X	X	X	X
Red crossbill (*Loxia curvirostra*)	X		X	
White-winged crossbill (*Loxia leucoptera*)	X		X	
Pine siskin (*Carduelis pinus*)	X		X	X
American goldfinch (*Carduelis tristis*)	X	X	X	X
Common redpoll (*Carduelis flammea*)	X	X	X	
Evening grosbeak (*Coccothraustes vespertinus*)	X	X	X	
House sparrow (*Passer domesticus*)	X	X	X	X
Total Number of Species	164	130	162	142

[a] Historical records include only confirmed species accounts taken from the NPSpecies database (National Park Service 2003).

[b] Species were detected on the Monongahela River adjacent to FRHI.

Table 6. Bird species of special concern detected during spring-migratory, breeding, fall-migratory, and winter seasons, September 2001 - July 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI).

Species	Status[a]	Park - Season[b]
Great blue heron	AW	FONE - B FRHI - B & F
American black duck [c]	AW	FRHI - W
Osprey	ST	FRHI - S
Bald eagle	FT & SE	FRHI - B & W
Northern goshawk	SV	FONE - S & W
Northern bobwhite	SV	FRHI - S
American woodcock	AW	FONE - S FRHI - S
Black-billed cuckoo	BCC	FONE - S, B, & F FRHI - S, B, & F
Northern saw-whet owl	BCC & SV	FONE - W
Yellow-bellied sapsucker	BCC	FONE - S, F, & W FRHI - S
Acadian flycatcher	BCC	FONE - S & B FRHI - S, B, & F
Yellow-bellied flycatcher	ST	FONE - S
Willow flycatcher	AW	FONE - S, B, & F
Wood thrush	BCC & AW	FONE - S, B, & F FRHI - S, B, & F
Swainson's thrush	SV	FONE - F FRHI - S & F
Blue-winged warbler	AW	FONE - B & F FRHI - S & B

Table 6. Bird species of special concern detected during spring-migratory, breeding, fall-migratory, and winter seasons, September 2001 - July 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	Status[a]	Park – Season[b]
Golden-winged warbler	BCC & AW	FONE - S & B
Cerulean warbler	BCC & AW	FONE - S, B, & F FRHI - S & B
Prairie warbler	BCC & AW	FONE - S & B FRHI - S, B, & F
Bay-breasted warbler	BCC & AW	FONE - S & F FRHI – S
Kentucky warbler	BCC & AW	FONE - S & B FRHI - S & B
Canada warbler	BCC & AW	FONE - F FRHI - S
Worm-eating warbler	BCC & AW	FONE - S FRHI – S
Louisiana waterthrush	BCC	FONE - S, B, & F FRHI - S & B
Summer tanager	SV	FRHI – S
Grasshopper sparrow	BCC	FONE - B FRHI – B & F

[a] The status of birds of special concern was determined from the following sources: federally endangered (FE), threatened (FT) (http://endangered.fws.gov/wildlife.html), or bird of conservation concern (BCC) (http://migratorybirds.fws.gov/reports/bcc2002); state endangered (SE), threatened (ST), critically imperiled (SCI), imperiled (SI), or vulnerable (SV) (http://www.dcnr.state.pa.us/forestry/pndi/pndiweb.htm); Audubon Watchlist (AW) (http://www.audubon.org/bird/watch).

[b] The season refers to the following time periods: spring migration (S) (15 April - 25 May), breeding (B) (25 May - 15 July), fall migration (F) (25 August - 10 October), and winter (W) (1 December - 15 March).

[c] American black duck was detected on the Monongahela River adjacent to FRHI.

The most abundant bird species detected by point-count surveys in forest cover type tended to be long-distance migrants (Appendix K). The six most abundant or common species were red-eyed vireo (1.06 average number/point/survey), black-throated green warbler (1.02), ovenbird (0.63), tufted titmouse (0.52), American goldfinch (0.48), and black-capped chickadee (0.42). Although all 10 of the most frequently detected long-distance migrant species breed within the park, two of the most prevalent short-distance migrants (ruby-crowned kinglet and yellow-rumped warbler) were transients.

Breeding Season: We observed 86 bird species at FONE during the 2002-03 breeding seasons (Appendix J). Twelve species, including six long-distance migrants (red-eyed vireo, wood thrush, black-throated green warbler, ovenbird, scarlet tanager, and indigo bunting), were categorized as abundant during the breeding season, based on all surveys combined. Additionally, 12 species, including five long-distance migrants, were classified as common. Most species (n = 30) were occasionally detected.

Six of the eight most frequently detected species in forest cover type during the breeding seasons were long-distance migrants (Appendix L). The five most abundant species at FONE, all of which are long-distance migrants, were red-eyed vireo (2.31 average number/point/survey), scarlet tanager (1.04), ovenbird (1.02), black-throated green warbler (0.81), and American redstart (0.60). Short-distance migrants were rare to uncommon in forest cover type at FONE during the breeding season; no species averaged more than 0.21 birds/point/survey.

Fall Migration: We recorded 87 bird species during the 2001-02 fall-migratory seasons at FONE (Appendix J). Six species were categorized as abundant during fall migration, based on all surveys combined, including five permanent residents (blue jay, American crow, black-capped chickadee, cedar waxwing, American goldfinch) and one short-distance migrant (eastern towhee). Most species (n = 40) were classified as occasionally occurring within the park.

Unlike spring and breeding seasons, eight of the nine most frequently detected species in forest cover type were permanent residents rather than long-distance or short-distance migrants (Appendix M). Only four long-distance migrants (eastern wood-pewee, red-eyed vireo, wood thrush, black-throated green warbler) and one short-distance migrant (eastern towhee) averaged greater than 0.1 bird/point/survey. The four most abundant species at forested point-count sampling points were black-capped chickadee (1.08 average number/point/survey), cedar waxwing (0.92), white-breasted nuthatch (0.77), and black-throated green warbler (0.56).

Winter Season: We noted 39 bird species during the 2001-02 and 2002-03 winter seasons at FONE (Appendix J). Only two species were categorized as abundant during the winter season based on all surveys combined (wild turkey and American crow). Additionally, black-capped chickadee and golden-crowned kinglet were common during the winter surveys. Most species (n = 22) were occasionally observed within the park.

Only one short-distance migrant, northern goshawk, was detected using point counts in forest cover type (Appendix N). The five most common species were black-capped chickadee (0.46 average number/point/survey), white-breasted nuthatch (0.35), tufted titmouse (0.33), golden-crowned kinglet (0.29), and downy woodpecker (0.25).

Friendship Hill National Historic Site

All Seasons Combined: We identified 142 bird species at FRHI from September 2001 – July 2003 using point-count, vehicular-road, diurnal raptor and vulture, strip-transect, owl, and riparian bird surveys (Table 5). We detected 131 of 162 (80.8%) bird species that had been historically confirmed at FRHI prior to our inventory (National Park Service 2003). Additionally, we detected 11 species not previously documented within the park including double-crested cormorant, canvasback, hooded merganser, black vulture, bald eagle, northern bobwhite, spotted sandpiper, fish crow, gray-cheeked thrush, Tennessee warbler, and grasshopper sparrow (Table 5). A majority of the species previously documented at FRHI but not recorded in our inventory were grassland associates (northern harrier, ring-necked pheasant, horned lark, and savannah sparrow), wetland associates (green heron, alder flycatcher, willow flycatcher, purple martin, bank swallow, marsh wren, and sedge wren), neotropical migratory transients (tundra swan, olive-sided flycatcher, yellow-bellied flycatcher, black-throated blue warbler, and Connecticut warbler), and transient, winter residents (northern goshawk, winter wren, American pipit, fox sparrow, Lincoln's sparrow, rusty blackbird, red and white-winged crossbills, common redpoll, and evening grosbeak).

Twenty-one species of special concern occurred at FRHI, including the federally threatened and state endangered bald eagle, state threatened osprey, and state vulnerable northern bobwhite, Swainson's thrush, and summer tanager (Table 6). Most (n = 18) species of special concern were found in the park during spring migration. We found 11 species of special concern that possibly breed within the park, including osprey, American woodcock, black-billed cuckoo, Acadian flycatcher, wood thrush, blue-winged warbler, cerulean warbler, prairie warbler, Kentucky warbler, Louisiana waterthrush, and grasshopper sparrow.

Spring Migration: We found the highest number of bird species at FRHI during the 2002-03 spring-migratory seasons (n = 116) (Appendix O). Based on all bird survey protocols combined for spring migration, 14 species (Canada goose, red-eyed vireo, blue jay, American crow, tufted titmouse, Carolina chickadee, wood thrush, American robin, European starling, ovenbird, eastern towhee, northern cardinal, red-winged blackbird, and American goldfinch) were categorized as abundant (i.e., located in large numbers and in more than one habitat). Of the 11 species categorized as common (i.e., located in fairly large numbers in appropriate habitat), seven were either short-distance (blue-gray gnatcatcher, yellow-rumped warbler, brown-headed cowbird) or long-distance migrants (eastern wood-pewee, scarlet tanager, indigo bunting, Baltimore oriole). The highest number of bird species (n = 35) was categorized as occasional (i.e., present in some parcels of appropriate habitat, but not certain to be detected), including 21 long-distance migrants.

The ten most abundant bird species detected by point-count surveys during the spring-migratory seasons included three long-distance migrants, two short-distance migrants, and five permanent residents (Appendix P). These species were eastern towhee (0.94 average number/point/survey), American goldfinch (0.84), red-eyed vireo (0.84), northern cardinal (0.75), American robin (0.65), Carolina chickadee (0.63), scarlet tanager (0.60), tufted titmouse (0.59), wood thrush

(0.59), and brown-headed cowbird (0.44). Ten of the 11 most frequently detected species of long-distance migrants and seven of the ten most frequently detected short-distance migrants breed within the park (Appendix P).

Breeding Season: We observed 81 bird species at FRHI during the 2002-03 breeding seasons (Appendix O). Sixteen species, including six long-distance migrants (Acadian flycatcher, red-eyed vireo, wood thrush, ovenbird, scarlet tanager, and indigo bunting), were categorized as abundant during the breeding season, based on all surveys combined. Additionally, 11 species, including three long-distance migrants, were classified as common (Appendix O). Most species (n = 28) were occasionally detected.

The six most abundant species detected by point-count surveys during the breeding seasons at FRHI represented long and short-distance migrants and permanent residents (Appendix Q). The six most abundant species were red-eyed vireo (1.31 average number/point/survey), northern cardinal (1.09), eastern towhee (0.75), scarlet tanager (0.72), tufted titmouse (0.68), and wood thrush (0.68).

Fall Migration: We recorded 84 bird species during the 2001-02 fall-migratory seasons at FRHI (Appendix O). Twelve species were categorized as abundant during fall migration, based on all surveys combined, including only one migratory species (chimney swift). Of the nine species classified as common, only two were migratory birds (eastern wood-pewee and eastern towhee). Most species (n = 34) were classified as occasionally occurring within the park.

Unlike spring and breeding seasons, seven of the eight most frequently detected species at point-count locations were permanent residents compared to long-distance or short-distance migrants during the spring and breeding seasons (Appendix R). Only three long-distance migrants (chimney swift, eastern wood-pewee, red-eyed vireo) and one short-distance migrant (eastern towhee) averaged greater than 0.1 bird/point/survey. The four most abundant species were cedar waxwing (1.85 average number/point/survey), chimney swift (1.54), blue jay (1.37), and northern cardinal (0.85).

Winter Season: We noted 54 bird species during the 2001-02 and 2002-03 winter seasons at FRHI (Appendix O). Eleven permanent resident bird species were categorized as abundant during the winter seasons based on all surveys combined. Additionally, six permanent residents and two short-distance migrants (golden-crowned kinglet and dark-eyed junco) were common during the winter surveys. Most species (n = 17) were occasionally observed within the park.

A large number (n = 10) of short-distance migrants was detected by point-count surveys; however, no short-distance migrant species averaged more than 0.07 birds/point/survey (Appendix S). The six most abundant or common species were Carolina chickadee (0.82 average number/point/survey), mourning dove (0.66), tufted titmouse (0.66), northern cardinal (0.59), American robin (0.41), and song sparrow (0.41).

Mammals

We detected 28 mammal species at FONE and FRHI combined from April 2002 - October 2003 (Table 7). Several species ranging in size from masked shrew to black bear (scientific names are given in Table 7) were present at the parks. Fifteen mammal species occurred at both parks. Three mammal species were located only at FRHI and 10 species were unique to FONE, including fisher, a species recently reintroduced into Pennsylvania.

Fort Necessity National Battlefield

All Surveys Combined: We detected 25 mammal species at FONE from April 2002 - October 2003 using trapping, vehicular-road surveys, and signs while conducting research at the park (Table 7). We detected all seven of the mammal species that had been historically confirmed at FONE prior to our inventory (National Park Service 2003). Additionally, we found 18 species not previously documented within the park including medium-sized mammals (Virginia opossum, fox squirrel, porcupine, gray fox, common raccoon, long-tailed weasel, striped skunk), small mammals including mice, shrews, and voles, and arboreal mammals (little brown myotis, big brown bat, and red bat). Only one species of special concern (fisher) occurred at the park.

Trapping Surveys: We recorded the highest number of mammal species (n = 14) between 28 July - 5 October 2002 and 2003 at FONE using trapping surveys. The nine species most commonly detected using trapping surveys included seven small mammal species and two medium-sized species (common raccoon and long-tailed weasel) (Appendix T). The four most commonly trapped species were white-footed mouse (0.41 average number/point/survey), deer mouse (0.07), masked shrew (0.05), and eastern chipmunk (0.04).

Vehicular-road Surveys: We recorded ten mammal species between 28 July - 4 October 2002 and 2003 at FONE using vehicular-road surveys. The seven species most commonly detected during vehicular-road surveys included one small (eastern chipmunk), five medium-sized (eastern cottontail, woodchuck, and gray, fox, and red squirrel), and one large (white-tailed deer) mammal (Appendix U). The three most commonly observed species were white-tailed deer (14.1 average number/survey), eastern chipmunk (7.7), and red squirrel (0.9).

Friendship Hill National Historic Site

All Surveys Combined: We detected 18 mammal species at FRHI from April 2002 - October 2003 using trapping, vehicular-road surveys, and signs while conducting research at the park (Table 7). We detected 12 of 18 (66.7%) mammal species that had been historically confirmed at FRHI prior to our inventory (National Park Service 2003). The six mammal species that we failed to detect during our inventory included big brown bat, southern flying squirrel, muskrat, Norway rat, woodland jumping mouse, and gray fox (Table 7). However, we found 6 species not previously documented within the park including masked shrew, short-tailed shrew, hairy-tailed mole, deer mouse, white-footed mouse, and meadow vole. No mammal species of special concern were identified at FRHI during our inventory.

Table 7. Mammal species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Virginia opossum (*Didelphis virginianus*)		X	X	X
Masked shrew (*Sorex cinereus*)		X		X
Short-tailed shrew (*Blarina brevicauda*)		X		X
Hairy-tailed mole (*Parascalops breweri*)				X
Little brown myotis (*Myotis lucifugus*)		X		
Big brown bat (*Eptesicus fuscus*)		X	X	
Red bat (*Lasiurus borealis*)		X		
Eastern cottontail (*Sylvilagus floridanus*)	X	X	X	X
Eastern chipmunk (*Tamias striatus*)	X	X	X	X
Woodchuck (*Marmota monax*)	X	X	X	X
Gray squirrel (*Sciurus carolinensis*)	X	X	X	X
Fox squirrel (*Sciurus niger*)		X	X	X
Red squirrel (*Tamiasciurus hudsonicus*)	X	X	X	X
Southern flying squirrel (*Glaucomys volans*)			X	
Beaver (*Castor canadensis*)			X	X

Table 7. Mammal species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Deer mouse (*Peromyscus maniculatus*)		X		X
White-footed mouse (*Peromyscus leucopus*)		X		X
Southern red-backed vole (*Clethrionomys gapperi*)		X		
Meadow vole (*Microtus pennsylvanicus*)		X		X
Muskrat (*Ondatra zibethicus*)			X	
Norway rat (*Rattus norvegicus*)			X	
Woodland jumping mouse (*Napaeozapus insignis*)		X	X	
Porcupine (*Erethizon dorsatum*)		X		
Red fox (*Vulpes vulpes*)			X	X
Gray fox (*Urocyon cinereoargenteus*)		X	X	
Black bear (*Ursus americanus*)	X	X		
Common raccoon (*Procyon lotor*)		X	X	X
Fisher (*Martes pennanti*)		X		
Long-tailed weasel (*Mustela frenata*)		X		

Table 7. Mammal species noted (indicated by an "X") from historical records versus species detected from September 2001 - October 2003 at Fort Necessity National Battlefield (FONE) and Friendship Hill National Historic Site (FRHI) (continued).

Species	FONE		FRHI	
	Historical Records[a]	Inventory Program	Historical Records[a]	Inventory Program
Striped skunk (*Mephitis mephitis*)		X	X	X
White-tailed deer (*Odocoileus virginianus*)	X	X	X	X
Total Number of Species	7	25	18	18

[a] Historical records include only confirmed species accounts taken from the NPSpecies database (National Park Service 2003).

Trapping Surveys: We recorded the highest number of mammalian species (n = 8) between 24 July - 15 October 2002 and 2003 at FRHI using trapping surveys. The six species most commonly trapped included four small mammal species and two medium-sized (Virginia opossum and common raccoon) species (Appendix V). The three species most commonly trapped were white-footed mouse (0.29 average number/point/survey), meadow vole (0.07), and deer mouse (0.04).

Vehicular-road surveys: We recorded seven mammal species between 24 July - 14 October 2002 and 2003 at FRHI using vehicular-road surveys. The seven species most commonly detected during vehicular-road surveys included one small (eastern chipmunk), five medium-sized (Virginia opossum, eastern cottontail, woodchuck, and gray and fox squirrel), and one large (white-tailed deer) mammal (Appendix W). The three species most commonly observed were white-tailed deer (12.8 average number/survey), gray squirrel (0.6), and fox squirrel (0.6).

Discussion

Birds

Species richness of birds at each park during 2001-03 was high, including 130 species at FONE and 142 species at FRHI (n = 157 for the parks combined). Most notably, 26 species of special concern used the parks, including 15 species during the breeding season. At both parks, the total number of species found was lower than the number recorded historically. Several factors contributed to the discrepancy between historically recorded versus currently observed number of species. First, resource management specialists (e.g., Roger Stone and Connie Ranson), in conjunction with members of local Audubon chapters (Dave Kruger and Dan Roddy), have emphasized documenting bird species at the parks since the early 1980's (National Park Service 2003), whereas we collected only 2 years of data. Second, since we collected only 2 years of data for each season, we may have failed to identify species that are rare (e.g., northern harrier, marsh and sedge wren, and Henslow's sparrow), of special concern (e.g., osprey and yellow-bellied flycatcher), irruptive (e.g., red and white-winged crossbills, common redpoll, and evening grosbeak), or secretive (e.g., Connecticut warbler and northern waterthrush) because these species may not occur at a park every year or may occur in such low densities that they are not easily detected. So, management specialists and members of local birding organizations who have compiled ornithological data at the parks since the early 1980's have documented rare and irruptive species that we were not able to detect in our 2-year study. Third, migratory transients, such as olive-sided flycatcher, Philadelphia vireo, gray-cheeked thrush, American pipit, and mourning warbler are present in the parks for a relatively short time during spring and fall. Therefore, not all species are detected every year within a given park during the migratory seasons. However, during 2 years of data collection, we documented three and 11 species at FONE and FRHI, respectively, that were not previously recorded at the parks. Although a large number of species has been documented, further inventorying and monitoring likely will continue to increase the number of species observed within each park.

The two national parks are unique with regard to cover types and land uses adjacent to the parks, making each an important location for bird conservation in southwestern Pennsylvania. To some extent, the abundance and distribution of cover types and landscape features within and surrounding the parks affected the number and type of bird species found within each park. For example, FONE contains both appreciable forest and extensive early successional cover types, is surrounded by forest cover and sparsely located grasslands/old fields, and is located within the Laurel Highlands of the Allegheny Mountains. FRHI also contains appreciable forest cover, but contains some mowed grasslands and scattered, early successional cover types, and is adjacent to a major river system, the Monongahela River. Additionally, FRHI is located within a more fragmented landscape than FONE. Not surprisingly, only FONE contained northern goshawk, breeding population of cerulean warbler, and black-throated blue warbler (i.e., three bird species associated with extensively forested habitats); also, alder flycatcher, willow flycatcher, and golden-winged warbler (i.e., early-successional associates) were found only at FONE. Landscape features, such as the Monongahela River, provide habitat and resources for riparian birds (e.g., double-crested cormorant, American black duck, canvasback, osprey, bald eagle, spotted sandpiper, and cliff swallow) and helped increase the number of species present at FRHI.

Cumulatively, these different cover types and landscape features, as well as important combinations of cover types associated with landscape features (e.g., early successional forest cover associated with the Monongahela River floodplain) present within parks, will continue to provide important resources and habitat for birds throughout the year.

Fort Necessity National Battlefield

The uniqueness of the avian community at each park can be attributed to many factors. At FONE, an extensive amount (265 ha) of contiguous deciduous, mixed, and coniferous forest cover types provide resources for a number of forest interior species during the breeding season (e.g., Acadian flycatcher, red-eyed vireo, cerulean warbler, blackburnian warbler, black-throated green warbler, ovenbird, and scarlet tanager). However, degradation and fragmentation of forested habitats, resulting from construction of a new Visitor's Center and changes to traffic patterns in the picnic area, pose threats to the future abundance and distribution of forest interior associates at the park. To the detriment of forest birds, future plans for expanding and paving the picnic area loop at the main unit of FONE will further fragment forest habitat within the park.

Additionally, species characteristic of open habitats (e.g., American woodcock, blue-winged warbler, golden-winged warbler, prairie warbler, yellow-breasted chat, and grasshopper sparrow) use the 106 ha of early successional, shrub habitat in the main unit of the park. Historically, early successional, shrub habitat was characterized to some extent by grassland and wet-meadow areas (Connie Ranson, personal communication), as evidenced by historical records of grassland (e.g., northern harrier, American kestrel, Henslow's sparrow, savannah sparrow, and bobolink) and wetland associates (e.g., purple martin, northern rough-winged swallow, and marsh and sedge wren). With vegetation clearing and mowing, proliferation of tartarian honeysuckle (*Lonicera tatarica*), and changes in hydrology surrounding and adjacent to the fort, both dominant vegetation and composition of the avian community within early successional habitat at FONE have changed over the past few decades. In conjunction with natural succession, these factors have created areas no longer suitable for grassland and wetland associates.

Future monitoring of avian populations at FONE is critical to help determine the impact of natural succession and human influences (i.e., construction of a Visitor's Center and roadways, manipulation of vegetation, and alteration of hydrologic patterns) on the composition of the bird community at the park. Continued monitoring of birds likely will result in documentation of additional species that are typical of interior forest and early successional habitat, as well as relatively rare migrants, and winter-irruptive species (e.g., olive-sided flycatcher, gray-cheeked thrush, mourning warbler, white-winged crossbill, and pine siskin).

Friendship Hill National Historic Site

The geographic location of FRHI significantly influenced the total number of species located at the park. Unlike FONE, FRHI is adjacent to the Monongahela River and, therefore, the bird community contains a number of water birds or species associated with riparian areas (e.g., double-crested cormorant, wood duck, American black duck, canvasback, hooded merganser, osprey, spotted sandpiper, cliff swallow, and northern rough-winged swallow). The Monongahela River, bordering the park to the north and west, provides resources for waterbirds

and serves as a migration corridor for short- and long-distance migrants during the spring and fall seasons. However, the recent shutdown of the acid mine drainage facility at FRHI and associated changes in water quality could directly (increased acidity and contaminants in perennial streams) or indirectly (changes in entomological and invertebrate ecology [bird food sources] associated with perennial streams) alter the abundance and/or composition of the bird community at FRHI. In addition to geographic location and the presence of multiple water sources, habitat associations within FRHI likely influence the bird community at the park. Similar to FONE, FRHI contains a large amount of forest cover type (over 200 ha of coniferous and deciduous forest) and provides habitat for breeding populations of area-sensitive species (e.g., wood thrush, ovenbird, and scarlet tanager). The centrally located 19 ha of annually mowed hayfields contained a limited number of grassland associates, including bobolink during spring migration and grasshopper sparrow, eastern meadowlark, and red-winged blackbird during the breeding season. Current practice is to mow these fields for hay during mid to late July. We suggest that these fields remain undisturbed until August to enable the grassland bird species to fledge their nests and begin to raise their young in suitable grassland cover.

Future monitoring of birds at the park likely will result in documentation of additional species that are typical of interior forest habitat and open grassland areas. Further, the presence of the Monongahela River and adjacent floodplain habitat as a migratory corridor increases the probability of documenting rare fall and spring migrants and winter-irruptive species at the park. Continued monitoring of bird populations will confirm the regional importance of FRHI to birds, especially during the migratory and breeding seasons for many species of special concern, including federally threatened and state-endangered bald eagle.

Mammals

Species richness of mammals at each park during 2001-03 included 25 species at FONE and 18 species at FRHI (n = 28 for the parks combined). However, only one species of special concern (i.e., fisher at FONE) was detected at the parks. Unlike the bird community, all mammals recorded at FONE and FRHI potentially bred within the parks. At both parks, the total number of species found was higher than (FONE) or equal to (FRHI) the number of species recorded historically. Several factors contributed to the discrepancy between historically recorded versus currently observed number of mammals. In the past, little emphasis was placed on recording mammal species at FONE, as exemplified by the documentation of only seven of the most common and easily recognizable species (i.e., eastern cottontail, eastern chipmunk, woodchuck, gray and red squirrel, black bear, and white-tailed deer). At FRHI, Dan Roddy of the Mountaineer Audubon Society spent time observing mammals during the late 1970's and early 1980's (National Park Service 2003), helping to tally 18 species prior to our research. During 2 years of data collection for our project, we documented 18 and 6 species at FONE and FRHI, respectively, that were not previously recorded at the parks. After combining historical records and data from our project, 25 and 24 mammal species have been recorded at FONE and FRHI, respectively. However, many additional species could be present that have not been located at one or both parks (Merritt 1987). Several terrestrial mammal species that possibly exist at the parks, but have yet to be recorded, include shrews (least shrew [*Cryptotis parva*], pygmy shrew [*Microsorex hoyi*], rock shrew [*Sorex dispar*], smoky shrew [*S. fumeus*], water shrew [*S. palustris*]), moles (hairy-tailed mole at FONE, star-nosed mole [*Condylura cristata*]), voles (rock

vole [*Microtus chrotorrhinus*], woodland vole [*M. pinetorum*]), southern bog lemming (*Synaptomys cooperi*), meadow jumping mouse (*Zapus hudsonius*), flying squirrels (northern flying squirrel [*Glaucomys sabrinas*], southern flying squirrel at FONE), and weasels (ermine [*Mustela erminea*], least weasel [*M. nivalis*], mink [*M. vision*], long-tailed weasel at FRHI). Although our inventory project was not designed to inventory bat species, researchers visually identified little brown myotis, big brown bat, and red bat at FONE between April 2002 and October 2003 to accompany the historical records of big brown bat at FRHI. Besides these bats, there are six or seven additional bat species that could possibly exist at FONE and FRHI during different times of the year. Even though a large number of terrestrial mammals have been documented at the two parks, future monitoring accompanied by an inventory specific to bats will continue to increase the number of mammal species observed within each park.

Birds

Point-count and Strip-transect Surveys

A bird-monitoring program at FONE and FRHI should be based on point-count surveys. Results from point-count surveys based on our survey protocol and conducted at our point-count sampling points will provide information on bird species richness and abundance that can be compared among years, among seasons, and to results from this project because of a standard time length (10 minutes) and survey protocol. This will provide the most reliable data and provide information on long-term trends in bird populations.

The highest species richness at each park was recorded during spring migration (113 species at FONE and 116 at FRHI). However, we documented a large number of species during other seasons that were not recorded during spring migration (18 species at FONE and 27 at FRHI); hence, many species may be overlooked if surveys are conducted only during spring migration. Surveys should be conducted during all seasons to maximize the number of species detected, thereby increasing the likelihood of observing uncommon winter residents (e.g., white-winged crossbill and evening grosbeak and) and late-arriving breeding species (e.g., yellow-billed cuckoo, ruby-throated hummingbird, and Acadian flycatcher).

Additionally, we recommend conducting strip-transect surveys along forested edges at both parks during the spring and fall migratory seasons. Information derived from the strip-transect surveys would complement information obtained from point-count and other surveys by increasing the likelihood of detecting rare and transient migrating passerines that may only be present within the parks for a short time.

Vehicular-road and Diurnal Raptor and Vulture Surveys

As a supplement to point-count surveys, vehicular-road surveys should be conducted to increase information on species richness and abundance of birds at FONE and FRHI. Vehicular-road surveys are inexpensive, non-labor intensive, and can be conducted during the same years as point-count surveys. However, because they are not particularly suitable for inventorying and monitoring forest-interior species, vehicular-road surveys should not replace point-count surveys unless time and monies are severely limited. As is true with vehicular-road surveys, diurnal raptor and vulture surveys require little time and effort. Qualified resource management specialists could conduct these surveys concurrently with vehicular-road surveys.

Owl and Riparian Bird Surveys

The nocturnal-owl survey protocol is the only survey method that provides an accurate estimate of species richness and abundance for owls. Because owls are inconspicuous and rarely vocalize during the day, other survey methods considerably underestimate the abundance of these species. Therefore, we recommend including owl surveys in a monitoring program.

Riparian bird surveys at FRHI should be conducted during winter, spring-migratory, and fall-migratory seasons to accurately determine species richness and abundance of riparian birds utilizing the Monongahela River and associated habitats within the park. We recommend conducting these surveys during migratory and winter seasons because of the dynamic nature of these populations. This also will improve the chances of increasing the species richness of riparian birds by documenting rare or migratory waterfowl and shorebirds that may be present within or adjacent to the park for a short time.

Mammals

Trapping Surveys

A mammal-monitoring program at FONE and FRHI should be based on trapping surveys. The highest species richness at each park was recorded using trapping surveys (14 species at FONE and 8 at FRHI). Results from trapping surveys based on our survey protocol and conducted at our sampling locations will provide information on mammal species richness and abundance and can be compared among years, among time periods, and to results from this project because of a standard survey protocol. This will provide the most reliable data, increase the likelihood of incorporating variable weather conditions (i.e., drought, heavy rains) and different phases of small mammal population cycles, and provide information on long-term trends in mammal populations.

Vehicular-road Surveys

As a supplement to trapping surveys, a monitoring program should include vehicular-road surveys to increase information on species richness and abundance of mammals at FONE and FRHI. These surveys provide information on abundance of medium to larger sized mammals (i.e., gray fox, black bear, and white-tailed deer) that is unattainable with trapping surveys. Vehicular-road surveys are inexpensive, non-labor intensive, and can be conducted during the same years as trapping surveys. However, because they are not particularly suitable for inventorying or monitoring mammals smaller than eastern chipmunks, vehicular-road surveys should not replace trapping surveys.

Additional Surveys

Although our inventory project did not target bat species, researchers were able to visually identify little brown myotis, big brown bat, and red bat at FONE between April 2002 and October 2003. Only big brown bat has been recorded at FRHI. Besides these three bats, there are six to seven additional bat species that could possibly exist at FONE and FRHI. If time, money, and experienced personnel are available, we recommend a formal inventory of bat species be conducted at both parks using echolocation detectors and general searches.

Conclusions

National parks are becoming more insular due to increased habitat fragmentation in the surrounding landscape. Thus, they have become extremely valuable for the long-term maintenance of bird and mammal diversity. The NPS determined the need to obtain a comprehensive inventory database on birds and mammals and obtain guidance for establishing a long-term monitoring program for bird and mammal populations at FONE and FRHI. Based on surveys of birds and mammals during this and previous research projects at Pennsylvania national parks (1992-2001), we recommend natural resource professionals employ survey protocols and locations used during this project to monitor bird populations at both parks. A monitoring program should include point-count, vehicular-road, and diurnal raptor and vulture surveys during all seasons, strip-transect surveys during spring and fall migratory seasons, and owl surveys during winter seasons. In addition, riparian-bird surveys should be conducted during winter and spring and fall migratory seasons at FRHI. To monitor mammals at FONE and FRHI, we recommend conducting trapping and vehicular-road surveys based on protocols and locations used for this inventory project. Additionally, to supplement the mammal inventory portion of our project, a formal inventory of bat species should be considered at FONE and FRHI.

By developing a monitoring program based on survey protocols and locations from our inventory project, resource management specialists will be creating an extensive, long-term database on bird and mammal populations and adding to information already accumulated on presence, relative abundance, and distribution of these fauna within each national park. Data collected during this project combined with future monitoring efforts will be valuable on a local scale with respect to the development at FONE and effects of acid mine drainage at FRHI, as information available in long-term databases will enable resource management specialists to make informed decisions on how to best manage natural resources within national parks. Additionally, these data will be valuable on a national scale if bird populations continue to experience long-term declines in the eastern United States.

Information Storage

Relative abundance and species richness of birds and mammals and location of sampling points, survey stations, trapping locations, and vehicular-road survey routes at each park are stored in hard copy and electronic format. The bird and mammal survey information and sampling points, survey stations, and trapping locations are available in this report and in Microsoft Access computer files. ArcView shape files containing locations of the sampling points, survey stations, trapping locations, and vehicular-road survey routes and their accompanying UTM coordinates are available at The Pennsylvania State University and at the natural resource office of the parks. Copies of this report, Microsoft Access computer files, and ArcView shape files are on file with Dr. Richard H. Yahner, Professor of Wildlife Conservation, The Pennsylvania State University; Mr. John Karish, Regional Chief Scientist, National Park Service Philadelphia Support Office; Mrs. Connie Ranson, Resource Management Specialist, FONE and FRHI.

In addition to reports and GIS data layers, we are providing information that will be used to update the records for FONE and FRHI in the Park Species section of the NPSpecies database. Relevant information from the inventory project will be transferred into Microsoft Access format to satisfy requirements for the Vouchers and Observations section of the NPSpecies database.

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Appendix A. Habitat information and geographic coordinates for mammal trapping locations (MT), bird point-count sampling points (PC), strip-transects (ST), and vehicular-road (VR), diurnal raptor and vulture (RV), and owl survey stations (OW) at Fort Necessity National Battlefield. Coordinates are universal transverse mercator (UTM) projection Zone 17N projected on the North American Datum (NAD) of 1983.

Point	Point Type	Cover Type	Spatial Location	Elevation	UTM-East	UTM-North
1	MT & PC	Mixed Forest	Interior	Low	620324	4408375
2	MT & PC	Early Successional	Stream Edge	Low	620680	4408272
3	PC	Terrestrial Unvegetated	---	Low	620973	4408289
4	MT & PC	Early Successional	Interior	Low	620547	4408155
5	MT & PC	Coniferous Forest	Road-Stream Edge	Low	621021	4408081
6	MT & PC	Coniferous Forest	Interior	Low	620080	4407877
7	MT & PC	Early Successional	Interior	Low	620216	4407863
8	MT & PC	Mixed Forest	Road Edge	Low	620535	4407858
9	MT & PC	Coniferous Forest	Road Edge	Low	620998	4407876
10	MT & PC	Deciduous Forest	Stream Edge	Low	619847	4407594
11	MT & PC	Mixed Forest	Interior	Low	620489	4407626
12	MT & PC	Mixed Forest	Stream Edge	Low	621198	4407640
13	PC	Annual Herbaceous	Interior	Low	621551	407568
14	MT & PC	Deciduous Forest	Road Edge	Low	620303	4407462
15	MT & PC	Deciduous Forest	Interior	Low	620616	4407451
16	MT & PC	Coniferous Forest	Interior	Low	620873	4407426
17	PC	Mixed Forest	Interior	Low	621612	4407383
18	MT & PC	Mixed Forest	Interior	Low	621228	4407235
19	MT & PC	Deciduous Forest	Interior	Low	619896	4407044
20	PC	Coniferous Forest	Stream Edge	Low	620297	4406979
21	MT & PC	Deciduous Forest	Interior	Low	619862	4410191
22	MT & PC	Mixed Forest	Interior	High	616252	4415428
23	MT & PC	Deciduous Forest	Interior	High	616406	4415202

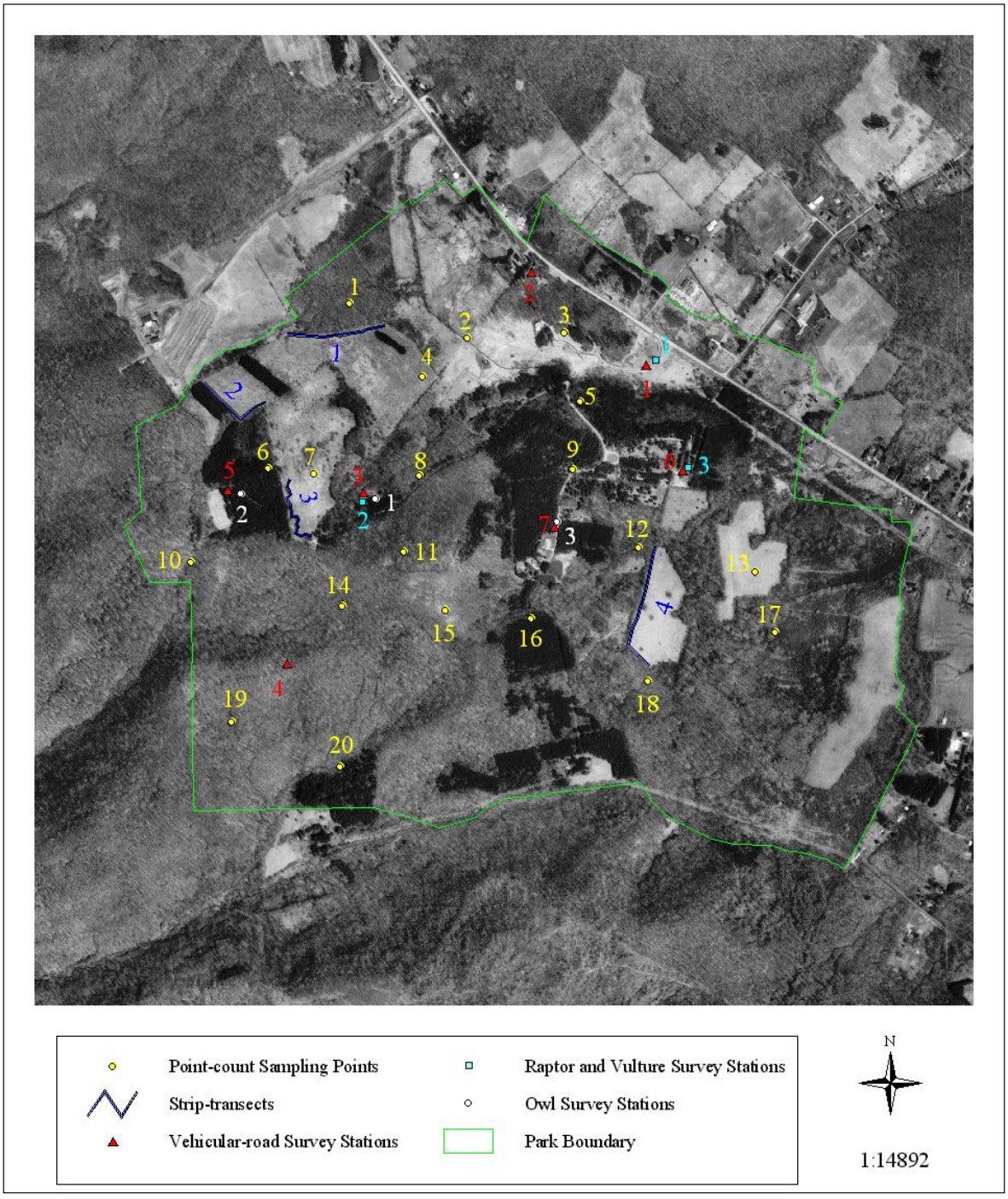
Appendix A. Habitat information and geographic coordinates for mammal trapping locations (MT), bird point-count sampling points (PC), strip-transects (ST), and vehicular-road (VR), diurnal raptor and vulture (RV), and owl survey stations (OW) at Fort Necessity National Battlefield. Coordinates are universal transverse mercator (UTM) projection Zone 17N projected on the North American Datum (NAD) of 1983 (continued).

Point	Point Type	Cover Type	Spatial Location	Elevation	UTM-East	UTM-North
24/1	MT & ST	Deciduous Forest - Early Successional	Interior	Low	620293	4408293
25/2	MT & ST	Mixed Forest - Perennial Herbaceous	Interior	Low	620143	4407753
26/3	MT & ST	Mixed Forest - Early Successional	Interior	Low	619899	4408112
27/4	MT & ST	Deciduous Forest - Perennial Herbaceous	Interior	Low	621201	4407467
1	VR	Early Successional	Road Edge	Low	621219	4408189
2	VR	Terrestrial Unvegetated	Road Edge	Low	620874	4408471
3	VR	Mixed Forest	Road Edge	Low	620367	4407807
4	VR	Deciduous Forest	Road Edge	Low	620136	4407289
5	VR	Coniferous Forest	Road Edge	Low	619957	4407813
6	VR	Mixed Forest	Road Edge	Low	621330	4407871
7	VR	Coniferous Forest	Road Edge	Low	620944	4407704
8	VR	Terrestrial Unvegetated	---	Low	619772	4410045
9	VR	Deciduous Forest	Road Edge	High	616049	4415257
1	RV	Early Successional	Road Edge	Low	621248	4408204
2	RV	Mixed Forest	Road Edge	Low	620364	4407773
3	RV	Mixed Forest	Road Edge	Low	621347	4407878
4	RV	Terrestrial Unvegetated	---	Low	619778	4410046
5	RV	Deciduous Forest	Road Edge	High	616053	4415264
1	OW	Mixed Forest	Road Edge	Low	620404	4407784
2	OW	Coniferous Forest	Road Edge	Low	619997	4407800
3	OW	Coniferous Forest	Road Edge	Low	620953	4407714

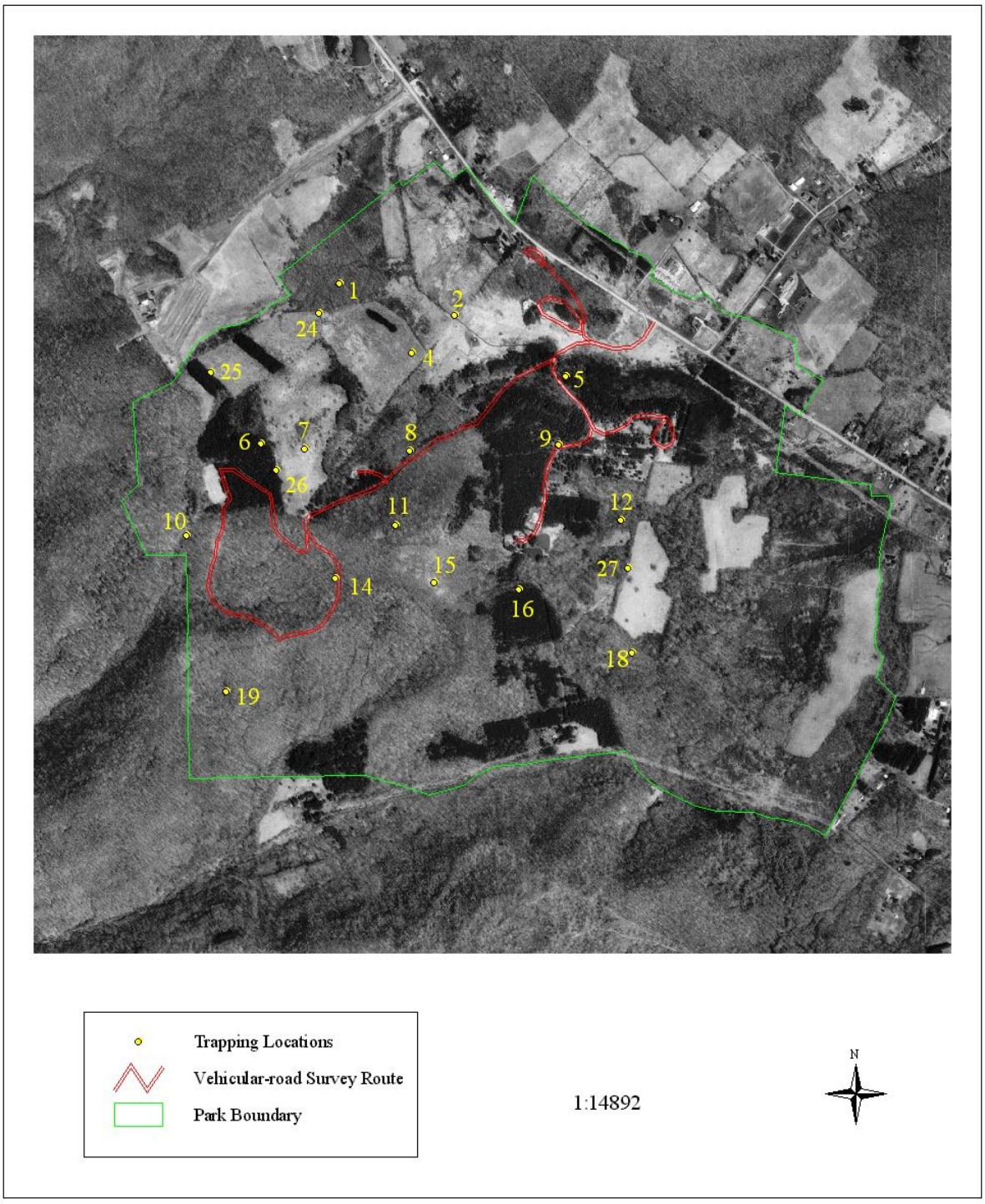
Appendix A. Habitat information and geographic coordinates for mammal trapping locations (MT), bird point-count sampling points (PC), strip-transects (ST), and vehicular-road (VR), diurnal raptor and vulture (RV), and owl survey stations (OW) at Fort Necessity National Battlefield. Coordinates are universal transverse mercator (UTM) projection Zone 17N projected on the North American Datum (NAD) of 1983 (continued).

Point	Point Type	Cover Type	Spatial Location	Elevation	UTM-East	UTM-North
4	OW	Mixed Forest	Stream Edge	Low	619865	4410197
5	OW	Deciduous Forest	Interior	High	616314	4415305

Appendix B. Location of bird point-count sampling points, strip-transects, and vehicular-road, diurnal raptor and vulture, and owl survey stations at the Main Unit of Fort Necessity National Battlefield.

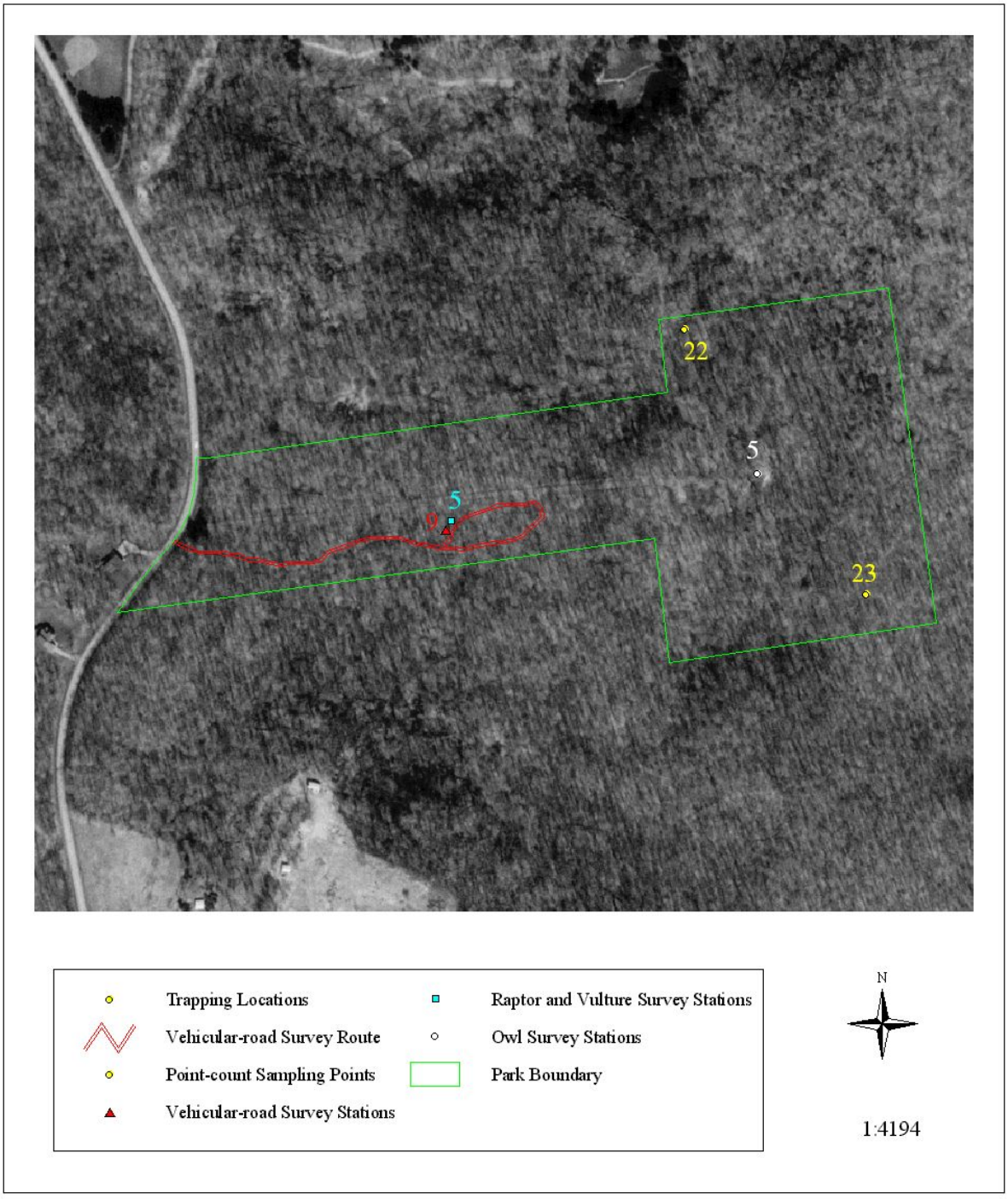


Appendix C. Location of mammal trapping locations and vehicular-road survey route at the Main Unit of Fort Necessity National Battlefield.



Appendix D. Location of mammal trapping location, vehicular-road survey route, bird point-count sampling point, and vehicular-road, diurnal raptor and vulture, and owl survey stations at the Braddock Grave Unit of Fort Necessity National Battlefield.

Appendix E. Location of mammal trapping locations, vehicular-road survey route, bird point-count sampling points, and vehicular-road, diurnal raptor and vulture, and owl survey stations at the Jumonville Glen Unit of Fort Necessity National Battlefield.



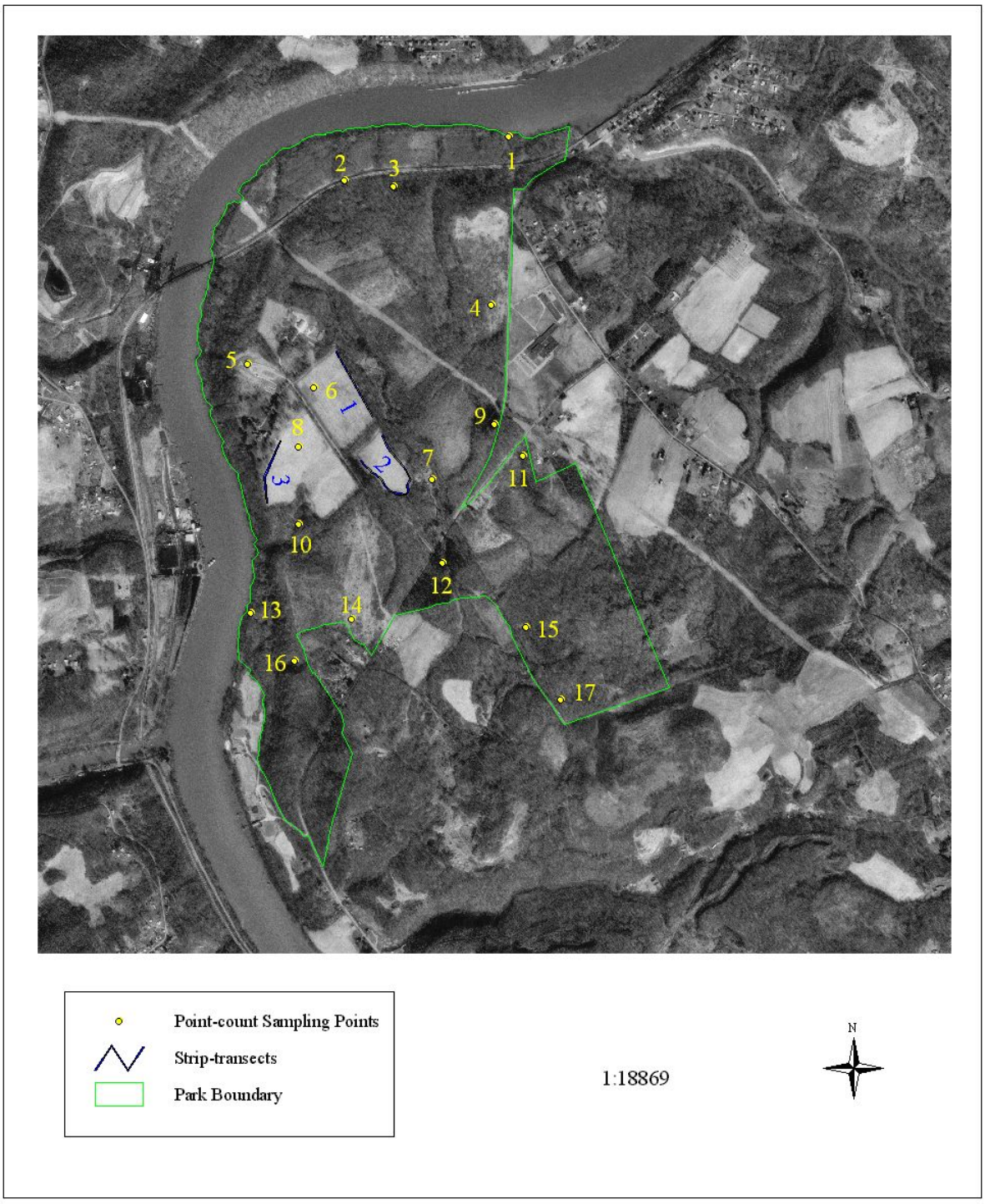
Appendix F. Habitat information and geographic coordinates for mammal trapping locations (MT), bird point-count sampling points (PC), strip-transects (ST), and vehicular- road (VR), diurnal raptor and vulture (RV), owl (OW), and riparian bird survey stations (RB) at Friendship Hill National Historic Site. Coordinates are universal transverse mercator (UTM) projection Zone 17N projected on the North American Datum (NAD) of 1983.

Point	Point Type	Cover Type	Spatial Location	UTM-East	UTM-North
1	MT & PC	Mixed Forest	Stream Edge	592475	4404560
2	MT & PC	Mixed Forest	Road Edge	591835	4404390
3	MT & PC	Mixed Forest	Interior	592032	4404357
4	MT & PC	Early Successional	Interior	592415	4403897
5	PC	Terrestrial Unvegetated	---	591452	4403662
6	MT & PC	Perennial Herbaceous	Interior	591709	4403575
7	MT & PC	Mixed Forest	Stream Edge	592185	4403213
8	MT & PC	Perennial Herbaceous	Interior	591654	4403339
9	MT & PC	Mixed Forest	Road Edge	592426	4403426
10	MT & PC	Mixed Forest	Interior	591654	4403038
11	MT & PC	Mixed Forest	Interior	592535	4403306
12	MT & PC	Coniferous Forest	Interior	592223	4402890
13	MT & PC	Mixed Forest	Stream Edge	591468	4402688
14	MT & PC	Early Successional	Interior	591868	4402666
15	MT & PC	Deciduous Forest	Interior	592552	4402644
16	MT & PC	Mixed Forest	Interior	591638	4402502
17	MT & PC	Deciduous Forest	Interior	592683	4402348
18/1	MT & ST	Mixed Forest - Perennial Herbaceous	Interior	591911	4403514
19/2	MT & ST	Mixed Forest - Perennial Herbaceous	Interior	592004	4403186
20/3	MT & ST	Mixed Forest - Perennial Herbaceous	Interior	591528	4403192
1	VR	Mixed Forest	Road Edge	592585	4404430

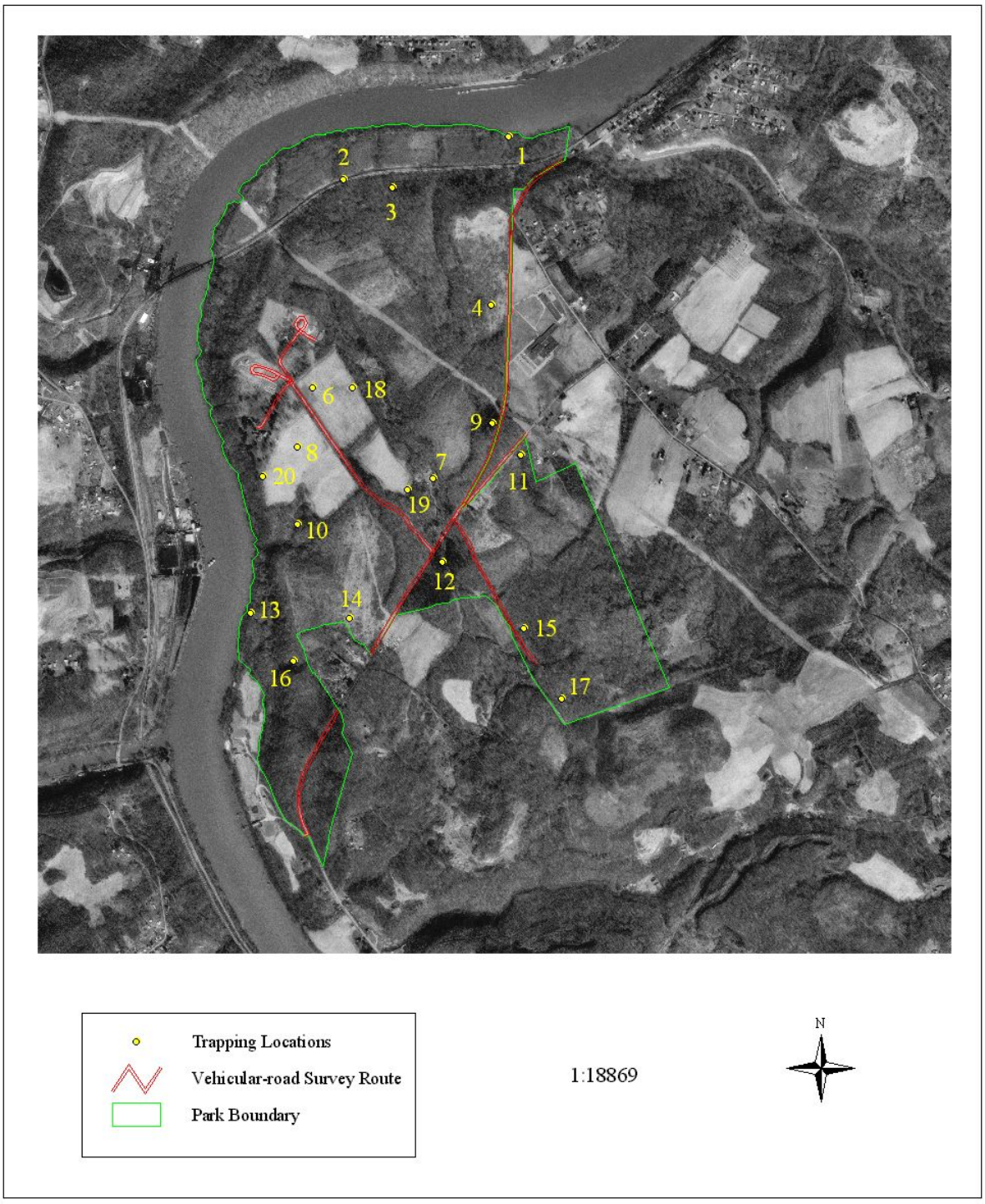
Appendix F. Habitat information and geographic coordinates for mammal trapping locations (MT), bird point-count sampling points (PC), strip-transects (ST), and vehicular- road (VR), diurnal raptor and vulture (RV), owl (OW), and riparian bird survey stations (RB) at Friendship Hill National Historic Site. Coordinates are universal transverse mercator (UTM) projection Zone 17N projected on the North American Datum (NAD) of 1983 (continued).

Point	Point Type	Cover Type	Spatial Location	UTM-East	UTM-North
2	VR	Deciduous Forest	Road Edge	592446	4402722
3	VR	Perennial Herbaceous	Road Edge	591809	4403318
4	VR	Terrestrial Unvegetated	---	591706	4403833
5	VR	Mixed Forest	Road Edge	591819	4402302
1	RV	Mixed Forest	River Edge	592453	4404555
2	RV	Perennial Herbaceous	Road Edge	591837	4403295
3	RV	Mixed Forest	Road Edge	591462	4403660
1	OW	Mixed Forest	Road Edge	592218	4404396
2	OW	Deciduous Forest	Interior	592661	4402375
3	OW	Terrestrial Unvegetated	---	591476	4403796
4	OW	Mixed Forest	Interior	591534	4402376
1	RB	River	River Edge	592469	4404587
2	RB	River	River Edge	591495	4402940
3	RB	River	River Edge	591277	4403610

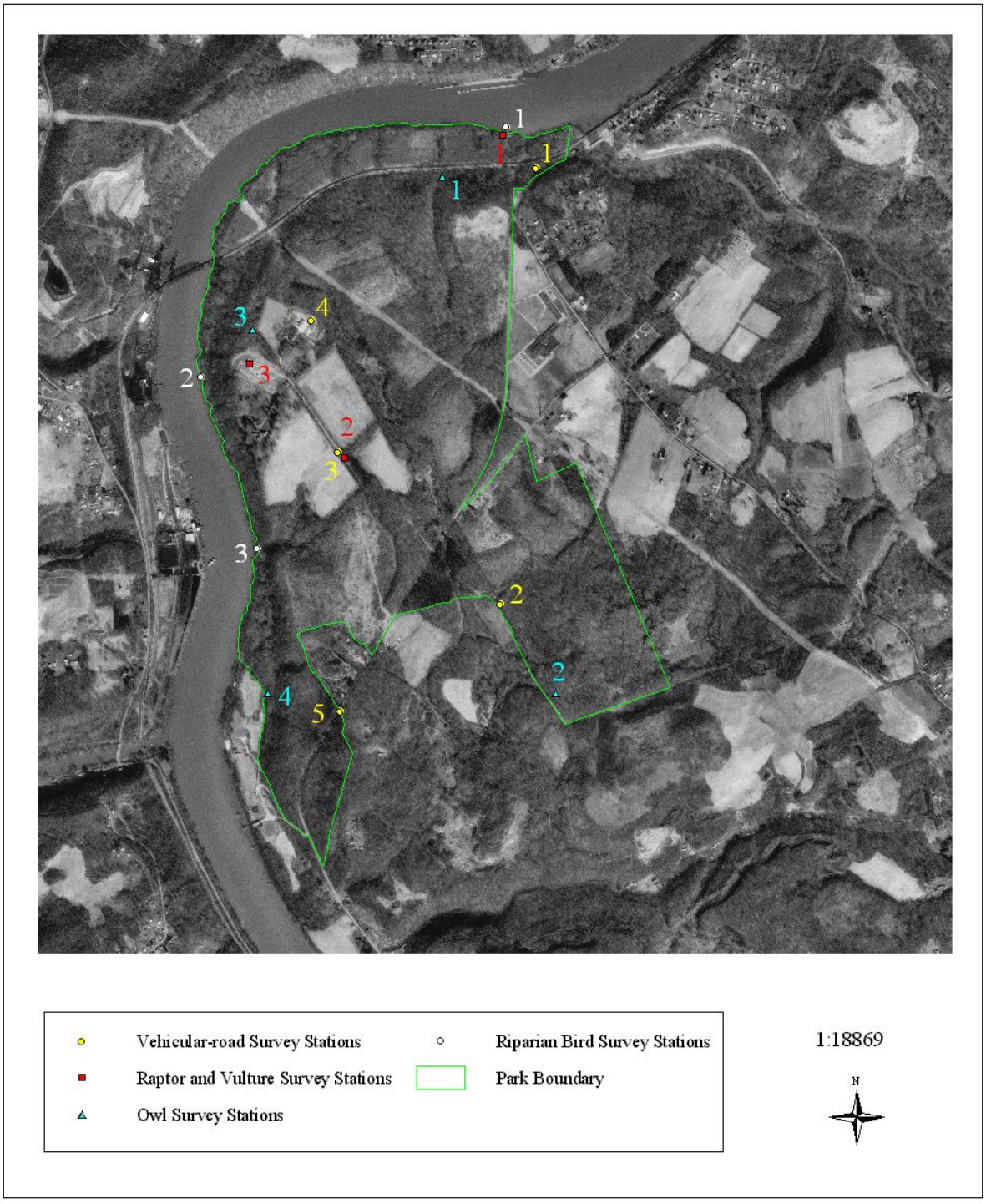
Appendix G. Location of bird point-count sampling points and strip-transects at Friendship Hill National Historic Site.



Appendix H. Location of mammal trapping locations and vehicular-road survey route at Friendship Hill National Historic Site.



Appendix I. Location of vehicular-road, diurnal raptor and vulture, owl, and riparian bird survey stations at Friendship Hill National Historic Site.



Appendix J. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Fort Necessity National Battlefield.

Species	Spring Migration	Breeding	Fall Migration	Winter
Green heron	--	R	--	--
Great blue heron	R	--	--	--
Canada goose	O	O	--	O
Mallard	O	--	--	--
Turkey vulture	C	C	C	O
Black vulture	--	R	--	R
Sharp-shinned hawk	R	--	R	--
Northern goshawk	R	--	--	R
Broad-winged hawk	O	R	R	--
Red-shouldered hawk	O	--	--	--
Red-tailed hawk	O	R	O	O
Wild turkey	C	U	U	A
Ruffed grouse	O	--	R	R
Killdeer	R	--	--	--
Least sandpiper	R	--	--	--
American woodcock	R	--	--	--
Mourning dove	O	O	O	--
Yellow-billed cuckoo	--	--	R	--
Black-billed cuckoo	O	R	R	--
Great horned owl	--	--	R	O
Barred owl	O	--	R	O
Eastern screech-owl	--	--	--	U
Northern saw-whet owl	--	--	--	R
Chimney swift	U	U	O	--
Ruby-throated hummingbird	O	O	O	--
Belted kingfisher	--	--	R	--
Red-bellied woodpecker	O	O	C	O

Appendix J. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Fort Necessity National Battlefield (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Northern flicker	U	O	U	O
Yellow-bellied sapsucker	R	--	R	O
Downy woodpecker	U	U	C	U
Hairy woodpecker	U	O	U	U
Pileated woodpecker	U	U	O	O
Eastern wood-pewee	O	C	U	--
Acadian flycatcher	O	C	--	--
Yellow-bellied flycatcher	R	--	--	--
Alder flycatcher	--	R	--	--
Willow flycatcher	O	R	R	--
Least flycatcher	R	--	O	--
Eastern phoebe	U	U	O	--
Great crested flycatcher	O	O	--	--
White-eyed vireo	O	O	--	--
Yellow-throated vireo	O	O	--	--
Blue-headed vireo	C	U	O	--
Red-eyed vireo	A	A	C	--
Warbling vireo	R	R	--	--
Blue jay	C	C	A	O
American crow	A	A	A	A
Common raven	O	O	O	O
Tree swallow	O	R	--	--
Barn swallow	O	R	--	--
Tufted titmouse	C	C	C	U
Black-capped chickadee	A	C	A	C
Carolina chickadee	R	--	--	--
Brown creeper	U	U	U	O

Appendix J. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Fort Necessity National Battlefield (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
White-breasted nuthatch	U	U	C	U
Red-breasted nuthatch	O	R	U	O
House wren	O	O	O	--
Winter wren	R	--	--	--
Carolina wren	O	O	O	O
Golden-crowned kinglet	O	O	O	C
Ruby-crowned kinglet	U	--	O	--
Blue-gray gnatcatcher	U	O	O	--
Eastern bluebird	O	--	O	O
Wood thrush	U	A	O	--
Swainson's thrush	--	--	R	--
Hermit thrush	R	O	O	--
American robin	C	A	C	O
Gray catbird	O	U	C	--
Northern mockingbird	O	--	--	--
Brown thrasher	U	O	--	--
European starling	O	--	O	U
Cedar waxwing	O	A	A	--
Blue-winged warbler	--	O	O	--
Golden-winged warbler	O	O	--	--
Tennessee warbler	O	--	O	--
Nashville warbler	O	R	R	--
Northern parula	U	U	R	--
Chestnut-sided warbler	U	C	O	--
Cape May warbler	O	--	O	--
Magnolia warbler	U	U	O	--
Yellow-rumped warbler	U	--	U	--

Appendix J. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Fort Necessity National Battlefield (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Black-and-white warbler	O	O	O	--
Black-throated blue warbler	O	--	O	--
Cerulean warbler	O	U	R	--
Blackburnian warbler	U	C	O	--
Black-throated green warbler	A	A	C	--
Yellow-throated warbler	R	--	--	--
Prairie warbler	U	U	O	--
Bay-breasted warbler	R	--	R	--
Blackpoll warbler	R	--	O	--
Pine warbler	O	R	O	--
Palm warbler	--	--	R	--
Yellow warbler	O	O	O	--
Kentucky warbler	O	O	--	--
Canada warbler	--	--	R	--
Wilson's warbler	--	--	O	--
Hooded warbler	O	U	O	--
Worm-eating warbler	R	--	--	--
Ovenbird	C	A	--	--
Louisiana waterthrush	O	O	R	--
Common yellowthroat	C	A	C	--
Yellow-breasted chat	O	O	O	--
American redstart	U	C	O	--
Scarlet tanager	U	A	O	--
Eastern towhee	A	A	A	--
American tree sparrow	--	--	--	O
Field sparrow	A	C	C	O
Chipping sparrow	C	A	O	--

Appendix J. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Fort Necessity National Battlefield (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Grasshopper sparrow	--	R	--	--
Fox sparrow	R	--	--	--
Lincoln's sparrow	--	--	R	--
Song sparrow	C	C	U	O
Vesper sparrow	R	R	--	--
Swamp sparrow	O	O	O	--
White-throated sparrow	O	--	O	R
Dark-eyed junco	O	--	--	U
Rose-breasted grosbeak	O	O	O	--
Northern cardinal	C	U	U	O
Indigo bunting	C	A	O	--
Eastern meadowlark	R	--	--	--
Red-winged blackbird	O	O	--	--
Common grackle	O	U	--	--
Brown-headed cowbird	U	O	--	--
Baltimore oriole	O	O	R	--
Purple finch	U	O	R	R
House finch	O	R	--	--
American goldfinch	A	C	A	O
Common redpoll	--	--	--	O

Appendix J. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Fort Necessity National Battlefield (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Evening grosbeak	O	--	--	--
House sparrow	O	O	--	--
Total Number of Species	113	86	87	39

[a] Relative abundance refers to the following categories: A = abundant (> 0.50 individuals/point per survey) should be located in large numbers and in more than one habitat; C = common (0.26 - 0.50 individuals/point per survey) should be located in fairly large numbers in appropriate habitat; U = uncommon (0.11 - 0.25 individuals/point per survey) present in appropriate habitat, but not located in large numbers; O = occasional (0.02 - 0.10 individuals/point per survey) present in some parcels of appropriate habitat, but not certain to be detected; R = rare ($\leq$ 0.01 individuals/point per survey) detected only a few times at most per season; -- = none detected during the season.

Appendix K. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points in forest cover type during spring-migratory seasons (15 April - 25 May, 2002 and 2003) at Fort Necessity National Battlefield.

Resident Status	Species	RA ± SD
Long-distant Migrant	Red-eyed vireo	1.06 ± 0.43
	Black-throated green warbler	1.02 ± 0.71
	Ovenbird	0.63 ± 0.38
	Scarlet tanager	0.35 ± 0.33
	American redstart	0.29 ± 0.26
	Wood thrush	0.23 ± 0.25
	Blackburnian warbler	0.21 ± 0.28
	Yellow-throated vireo	0.17 ± 0.25
	Acadian flycatcher	0.13 ± 0.20
	Black-and-white Warbler	0.13 ± 0.20
	Hooded warbler	0.13 ± 0.25
Short-distance Migrant	Yellow-rumped warbler	0.40 ± 0.41
	Blue-headed vireo	0.33 ± 0.29
	Eastern towhee	0.33 ± 0.36
	Blue-gray gnatcatcher	0.23 ± 0.34
	Brown-headed cowbird	0.19 ± 0.26
	Chipping sparrow	0.08 ± 0.16
	Common yellowthroat	0.04 ± 0.14
	Ruby-crowned kinglet	0.04 ± 0.10

Appendix K. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points in forest cover type during spring-migratory seasons (15 April - 25 May, 2002 and 2003) at Fort Necessity National Battlefield (continued).

Resident Status	Species	RA $\pm$ SD
Permanent Resident	Tufted titmouse	0.52 $\pm$ 0.49
	American goldfinch	0.48 $\pm$ 0.53
	Black-capped chickadee	0.42 $\pm$ 0.57
	American crow	0.35 $\pm$ 0.59
	White-breasted nuthatch	0.33 $\pm$ 0.43
	American robin	0.27 $\pm$ 0.41
	Downy woodpecker	0.25 $\pm$ 0.28
	Hairy woodpecker	0.17 $\pm$ 0.31
	Brown creeper	0.15 $\pm$ 0.17
	Purple finch	0.13 $\pm$ 0.25

Appendix L. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points in forest cover type during breeding seasons (25 May - 15 July, 2002 and 2003) at Fort Necessity National Battlefield.

Resident Status	Species	RA ± SD
Long-distant Migrant	Red-eyed vireo	2.31 ± 0.60
	Scarlet tanager	1.04 ± 0.58
	Ovenbird	1.02 ± 0.94
	Black-throated green warbler	0.81 ± 0.67
	American redstart	0.60 ± 0.59
	Acadian flycatcher	0.50 ± 0.64
	Eastern wood-peewee	0.46 ± 0.50
	Wood thrush	0.40 ± 0.46
	Cerulean warbler	0.29 ± 0.41
	Blackburnian warbler	0.27 ± 0.59
	Hooded warbler	0.27 ± 0.38
Short-distance Migrant	Eastern towhee	0.21 ± 0.26
	Blue-headed vireo	0.15 ± 0.20
	Blue-gray gnatcatcher	0.13 ± 0.29
	Common yellowthroat	0.10 ± 0.25
	Brown-headed cowbird	0.08 ± 0.12
	Chipping sparrow	0.04 ± 0.10
	Hermit thrush	0.02 ± 0.07
	Brown thrasher	0.02 ± 0.07
	Pine warbler	0.02 ± 0.07

Appendix L. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points in forest cover type during breeding seasons (25 May - 15 July, 2002 and 2003) at Fort Necessity National Battlefield (continued).

Resident Status	Species	RA $\pm$ SD
Permanent Resident	American robin	0.58 $\pm$ 0.33
	Cedar waxwing	0.46 $\pm$ 0.73
	White-breasted nuthatch	0.31 $\pm$ 0.29
	Black-capped chickadee	0.29 $\pm$ 0.42
	Blue jay	0.23 $\pm$ 0.20
	Tufted titmouse	0.23 $\pm$ 0.38
	Hairy woodpecker	0.19 $\pm$ 0.34
	American crow	0.19 $\pm$ 0.44
	American goldfinch	0.17 $\pm$ 0.16
	Brown creeper	0.13 $\pm$ 0.23
	Pileated woodpecker	0.13 $\pm$ 0.17

Appendix M. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points in forest cover type during fall-migratory seasons (25 August - 10 October, 2001 and 2002) at Fort Necessity National Battlefield.

Resident Status	Species	RA ± SD
Long-distant Migrant	Black-throated green warbler	0.56 ± 0.39
	Red-eyed vireo	0.35 ± 0.53
	Eastern wood-peewee	0.31 ± 0.30
	Wood thrush	0.13 ± 0.20
	Black-throated blue warbler	0.08 ± 0.16
	Rose-breasted grosbeak	0.08 ± 0.16
	Magnolia warbler	0.06 ± 0.16
	American redstart	0.04 ± 0.14
Short-distance Migrant	Eastern towhee	0.19 ± 0.30
	Common yellowthroat	0.08 ± 0.19
	Blue-headed vireo	0.06 ± 0.16
	Pine warbler	0.06 ± 0.16
	Blue-gray gnatcatcher	0.02 ± 0.07
	Hermit thrush	0.02 ± 0.07

Appendix M. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points in forest cover type during fall-migratory seasons (25 August - 10 October, 2001 and 2002) at Fort Necessity National Battlefield (continued).

Resident Status	Species	RA $\pm$ SD
Permanent Resident	Black-capped chickadee	1.08 $\pm$ 1.00
	Cedar waxwing	0.92 $\pm$ 0.81
	White-breasted nuthatch	0.77 $\pm$ 0.47
	Wild turkey	0.52 $\pm$ 1.30
	Blue jay	0.48 $\pm$ 0.38
	American goldfinch	0.42 $\pm$ 0.37
	Red-bellied woodpecker	0.38 $\pm$ 0.45
	American robin	0.38 $\pm$ 0.47
	American crow	0.35 $\pm$ 0.83
	Downy woodpecker	0.31 $\pm$ 0.34
	Tufted titmouse	0.29 $\pm$ 0.33
	Hairy woodpecker	0.23 $\pm$ 0.29

Appendix N. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected short-distance migrant and permanent-resident bird species identified from point-count sampling points in forest cover type during winter seasons (1 December - 15 March, 2001-02 and 2002-03) at Fort Necessity National Battlefield.

Resident Status	Species	RA ± SD
Short-distance Migrant	Northern goshawk	0.02 ± 0.07
Permanent Resident	Black-capped chickadee	0.46 ± 0.45
	White-breasted nuthatch	0.35 ± 0.39
	Tufted titmouse	0.33 ± 0.36
	Golden-crowned kinglet	0.29 ± 0.32
	Downy woodpecker	0.25 ± 0.34
	Hairy woodpecker	0.21 ± 0.30
	Wild turkey	0.19 ± 0.58
	Red-bellied woodpecker	0.06 ± 0.11
	Brown creeper	0.04 ± 0.09
	Northern cardinal	0.04 ± 0.14
	American goldfinch	0.04 ± 0.09
	Pileated woodpecker	0.04 ± 0.09

Appendix O. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Friendship Hill National Historic Site.

Species	Spring Migration	Breeding	Fall Migration	Winter
Double-crested cormorant	R	--	--	--
Great blue heron	R	R	O	--
Canada goose	A	U	O	A
Wood duck	R	--	--	--
Mallard	O	O	C	A
American black duck	--	--	--	U
Canvasback	--	--	--	R
Hooded merganser	--	--	--	U
Turkey vulture	C	A	A	O
Black vulture	O	--	--	--
Osprey	R	--	--	--
Bald eagle	--	R	--	R
Sharp-shinned hawk	--	--	--	O
Cooper’s hawk	--	--	--	O
Broad-winged hawk	O	--	O	--
Red-shouldered hawk	U	O	O	R
Red-tailed hawk	U	O	O	O
American kestrel	--	R	--	--
Wild turkey	U	O	A	A
Northern bobwhite	R	--	--	--
Killdeer	R	R	O	U
Spotted sandpiper	--	--	R	--
American woodcock	R	--	--	--
Rock dove	--	--	--	U
Mourning dove	O	O	U	A
Yellow-billed cuckoo	--	O	O	--
Black-billed cuckoo	O	R	--	--

Appendix O. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Friendship Hill National Historic Site (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Great horned owl	--	R	--	O
Barred owl	--	--	--	U
Eastern screech-owl	--	--	R	U
Common nighthawk	--	--	O	--
Chimney swift	U	C	A	--
Ruby-throated hummingbird	O	O	O	--
Belted kingfisher	U	O	U	U
Red-bellied woodpecker	C	C	C	C
Northern flicker	O	U	C	U
Yellow-bellied sapsucker	R	--	--	--
Downy woodpecker	U	U	U	C
Hairy woodpecker	O	U	O	O
Pileated woodpecker	U	U	C	O
Eastern wood-pewee	C	C	C	--
Acadian flycatcher	U	A	O	--
Least flycatcher	O	--	O	--
Eastern phoebe	U	O	O	O
Great crested flycatcher	O	O	R	--
Eastern kingbird	R	--	--	--
White-eyed vireo	O	O	O	--
Yellow-throated vireo	U	U	R	--
Blue-headed vireo	R	--	O	--
Red-eyed vireo	A	A	U	--
Philadelphia vireo	O	--	R	--
Warbling vireo	O	R	--	--
Blue jay	A	A	A	A
American crow	A	A	A	A

Appendix O. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Friendship Hill National Historic Site (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Fish crow	R	--	--	--
Common raven	--	O	O	--
Tree swallow	--	O	--	--
Cliff swallow	R	--	--	--
Northern rough-winged swallow	O	O	--	--
Barn swallow	U	C	--	--
Tufted titmouse	A	A	A	A
Black-capped chickadee	U	--	U	U
Carolina chickadee	A	C	A	A
Brown creeper	--	--	--	O
White-breasted nuthatch	U	U	C	C
Red-breasted nuthatch	R	--	--	O
House wren	O	O	R	--
Carolina wren	U	C	A	C
Golden-crowned kinglet	--	--	--	C
Ruby-crowned kinglet	U	--	O	--
Blue-gray gnatcatcher	C	C	--	--
Eastern bluebird	U	O	C	C
Wood thrush	A	A	O	--
Veery	R	R	O	--
Gray-cheeked thrush	--	--	R	--
Swainson’s thrush	R	--	O	--
Hermit thrush	O	--	--	--
American robin	A	A	A	C
Gray catbird	U	U	O	R
Northern mockingbird	O	--	--	O
Brown thrasher	O	R	--	--

Appendix O. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Friendship Hill National Historic Site (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
European starling	A	A	C	A
Cedar waxwing	U	U	A	--
Blue-winged warbler	U	O	--	--
Tennessee warbler	R	--	O	--
Nashville warbler	O	--	--	--
Northern parula	O	O	R	--
Chestnut-sided warbler	O	R	R	--
Cape May warbler	R	--	--	--
Magnolia warbler	U	--	O	--
Yellow-rumped warbler	C	--	O	O
Black-and-white warbler	O	--	--	--
Cerulean warbler	R	O	--	--
Blackburnian warbler	O	--	R	--
Black-throated green warbler	O	O	O	--
Yellow-throated warbler	U	O	--	--
Prairie warbler	R	O	--	--
Bay-breasted warbler	R	--	--	--
Blackpoll warbler	O	--	R	--
Pine warbler	--	--	R	--
Palm warbler	R	--	--	--
Yellow warbler	O	O	--	--
Mourning warbler	--	--	R	--
Kentucky warbler	O	O	--	--
Canada warbler	R	--	--	--
Wilson’s warbler	R	--	--	--
Hooded warbler	O	O	R	--
Worm-eating warbler	R	--	--	--

Appendix O. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Friendship Hill National Historic Site (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Ovenbird	A	A	O	--
Louisiana waterthrush	U	U	--	--
Northern waterthrush	R	--	R	--
Common yellowthroat	U	C	U	--
Yellow-breasted chat	O	O	R	--
American redstart	O	O	R	--
Summer tanager	R	--	--	--
Scarlet tanager	C	A	O	--
Eastern towhee	A	A	C	R
American tree sparrow	R	--	--	O
Field sparrow	C	U	O	--
Chipping sparrow	U	C	O	--
Grasshopper sparrow	--	R	R	--
Song sparrow	C	A	U	A
Vesper sparrow	O	--	R	O
Swamp sparrow	--	--	--	R
White-throated sparrow	U	--	R	O
White-crowned sparrow	R	--	--	--
Dark-eyed junco	--	--	--	C
Rose-breasted grosbeak	O	R	O	--
Northern cardinal	A	A	A	A
Indigo bunting	C	A	O	--
Bobolink	R	--	--	--
Eastern meadowlark	U	U	--	--
Red-winged blackbird	A	A	U	U
Common grackle	O	U	O	O
Brown-headed cowbird	C	C	R	--

Appendix O. Relative abundance[a] of bird species identified during spring-migratory (15 April - 25 May), breeding (25 May - 15 July), fall-migratory (25 August - 10 October), and winter seasons (1 December - 15 March), September 2001 - July 2003 at Friendship Hill National Historic Site (continued).

Species	Spring Migration	Breeding	Fall Migration	Winter
Orchard oriole	O	O	--	--
Baltimore oriole	C	U	--	--
Purple finch	O	--	--	--
House finch	R	R	O	O
Pine siskin	--	--	--	R
American goldfinch	A	C	A	U
House sparrow	--	--	O	--
Total Number of Species	116	81	84	54

[a] Relative abundance refers to the following categories: A = abundant (> 0.50 individuals/point per survey) should be located in large numbers and in more than one habitat; C = common (0.26 - 0.50 individuals/point per survey) should be located in fairly large numbers in appropriate habitat; U = uncommon (0.11 - 0.25 individuals/point per survey) present in appropriate habitat, but not located in large numbers; O = occasional (0.02 - 0.10 individuals/point per survey) present in some parcels of appropriate habitat, but not certain to be detected; R = rare ($\leq$ 0.01 individuals/point per survey) detected only a few times at most per season; -- = none detected during the season.

Appendix P. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points during spring-migratory seasons (15 April - 25 May, 2002 and 2003) at Friendship Hill National Historic Site.

Resident Status	Species	RA ± SD
Long-distant Migrant	Red-eyed vireo	0.84 ± 0.59
	Scarlet tanager	0.60 ± 0.63
	Wood thrush	0.59 ± 0.79
	Ovenbird	0.32 ± 0.61
	Baltimore oriole	0.25 ± 0.29
	Barn swallow	0.24 ± 0.61
	Eastern wood-peewee	0.22 ± 0.29
	Indigo bunting	0.22 ± 0.29
	Acadian flycatcher	0.21 ± 0.33
	Blue-winged warbler	0.18 ± 0.34
	Magnolia warbler	0.18 ± 0.19
Short-distance Migrant	Eastern towhee	0.94 ± 0.71
	Brown-headed cowbird	0.44 ± 0.35
	Blue-gray gnatcatcher	0.43 ± 0.52
	Red-winged blackbird	0.40 ± 1.32
	Gray catbird	0.21 ± 0.67
	Common yellowthroat	0.21 ± 0.29
	Ruby-crowned kinglet	0.18 ± 0.26
	White-throated sparrow	0.16 ± 0.34
	Yellow-rumped warbler	0.12 ± 0.22
	Eastern phoebe	0.10 ± 0.15

Appendix P. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points during spring-migratory seasons (15 April - 25 May, 2002 and 2003) at Friendship Hill National Historic Site (continued).

Resident Status	Species	RA $\pm$ SD
Permanent Resident	American goldfinch	0.84 $\pm$ 1.35
	Northern cardinal	0.75 $\pm$ 0.64
	American robin	0.65 $\pm$ 0.68
	Carolina chickadee	0.63 $\pm$ 0.79
	Tufted titmouse	0.59 $\pm$ 0.43
	Blue Jay	0.41 $\pm$ 0.47
	Song sparrow	0.41 $\pm$ 0.57
	Turkey vulture	0.29 $\pm$ 1.09
	Field sparrow	0.29 $\pm$ 0.64
	European starling	0.26 $\pm$ 1.03

Appendix Q. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points during breeding seasons (25 May - 15 July, 2002 and 2003) at Friendship Hill National Historic Site.

Resident Status	Species	RA ± SD
Long-distant Migrant	Red-eyed vireo	1.31 ± 0.90
	Scarlet tanager	0.72 ± 0.76
	Wood thrush	0.68 ± 0.91
	Acadian flycatcher	0.59 ± 0.73
	Ovenbird	0.51 ± 0.90
	Indigo bunting	0.47 ± 0.62
	Chimney swift	0.28 ± 0.77
	Eastern wood-peewee	0.28 ± 0.62
	Louisiana waterthrush	0.16 ± 0.28
	Yellow-throated vireo	0.13 ± 0.20
	Kentucky warbler	0.12 ± 0.25
Short-distance Migrant	Eastern towhee	0.75 ± 0.74
	Brown-headed cowbird	0.50 ± 0.58
	Blue-gray gnatcatcher	0.41 ± 0.46
	Red-winged blackbird	0.37 ± 1.00
	Gray catbird	0.24 ± 0.61
	Common yellowthroat	0.24 ± 0.42
	Chipping sparrow	0.19 ± 0.66
	Eastern meadowlark	0.13 ± 0.40

Appendix Q. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points during breeding seasons (25 May - 15 July, 2002 and 2003) at Friendship Hill National Historic Site (continued).

Resident Status	Species	RA $\pm$ SD
Permanent Resident	Northern cardinal	1.09 $\pm$ 0.66
	Tufted titmouse	0.68 $\pm$ 0.68
	American robin	0.57 $\pm$ 0.47
	European starling	0.44 $\pm$ 0.97
	Carolina chickadee	0.43 $\pm$ 0.43
	Blue jay	0.34 $\pm$ 0.36
	Song sparrow	0.29 $\pm$ 0.62
	American goldfinch	0.24 $\pm$ 0.40
	Carolina wren	0.21 $\pm$ 0.34
	Field sparrow	0.19 $\pm$ 0.56
	Red-bellied woodpecker	0.19 $\pm$ 0.27

Appendix R. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points during fall-migratory seasons (25 August – 10 October, 2002 and 2003) at Friendship Hill National Historic Site.

Resident Status	Species	RA ± SD
Long-distant Migrant	Chimney swift	1.54 ± 2.74
	Eastern wood-peewee	0.15 ± 0.29
	Red-eyed vireo	0.15 ± 0.15
	Ruby-throated hummingbird	0.10 ± 0.20
	Scarlet tanager	0.10 ± 0.18
	Wood thrush	0.09 ± 0.18
	Common nighthawk	0.06 ± 0.24
	Black-throated green warbler	0.06 ± 0.14
	Magnolia warbler	0.06 ± 0.17
	Rose-breasted grosbeak	0.06 ± 0.14
Short-distance Migrant	Eastern towhee	0.28 ± 0.45
	Gray catbird	0.10 ± 0.20
	Common yellowthroat	0.10 ± 0.15
	White-eyed vireo	0.04 ± 0.13
	Red-winged blackbird	0.04 ± 0.18
	Killdeer	0.03 ± 0.12
	Blue-headed vireo	0.03 ± 0.12
	Chipping sparrow	0.03 ± 0.12
	Grasshopper sparrow	0.03 ± 0.12
	Yellow-rumped warbler	0.03 ± 0.12

Appendix R. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected long-distance migrant, short-distance migrant, and permanent-resident bird species identified from point-count sampling points during fall-migratory seasons (25 August – 10 October, 2002 and 2003) at Friendship Hill National Historic Site (continued).

Resident Status	Species	RA ± SD
Permanent Resident	Cedar waxwing	1.85 ± 2.87
	Blue Jay	1.37 ± 1.12
	Northern cardinal	0.85 ± 0.95
	American robin	0.78 ± 1.61
	American goldfinch	0.75 ± 1.21
	Carolina chickadee	0.66 ± 0.63
	Tufted titmouse	0.63 ± 0.67
	Carolina wren	0.46 ± 0.44
	Black-capped chickadee	0.43 ± 0.63
	Red-bellied woodpecker	0.40 ± 0.43

Appendix S. Relative abundance (RA) (average number/point/survey) and standard deviation (SD) between sampling points of the most frequently detected short-distance migrant and permanent-resident bird species identified from point-count sampling points during winter seasons (1 December - 15 March, 2001-02 and 2002-03) at Friendship Hill National Historic Site.

Resident Status	Species	RA $\pm$ SD
Short-distance Migrant	Red-winged blackbird	0.07 $\pm$ 0.19
	Yellow-rumped warbler	0.06 $\pm$ 0.19
	White-throated sparrow	0.06 $\pm$ 0.16
	Hooded merganser	0.04 $\pm$ 0.18
	Eastern towhee	0.03 $\pm$ 0.08
	Vesper sparrow	0.03 $\pm$ 0.08
	Eastern phoebe	0.01 $\pm$ 0.06
	Gray catbird	0.01 $\pm$ 0.06
	American tree sparrow	0.01 $\pm$ 0.06
	Pine siskin	0.01 $\pm$ 0.06
Permanent Resident	Carolina chickadee	0.82 $\pm$ 0.79
	Mourning dove	0.66 $\pm$ 2.73
	Tufted titmouse	0.66 $\pm$ 0.53
	Northern cardinal	0.59 $\pm$ 0.73
	American robin	0.41 $\pm$ 0.90
	Song sparrow	0.41 $\pm$ 0.57
	Dark-eyed junco	0.28 $\pm$ 0.64
	White-breasted nuthatch	0.26 $\pm$ 0.25
	American crow	0.25 $\pm$ 0.57
	Carolina wren	0.24 $\pm$ 0.42

Appendix T. Relative abundance (RA) (average number/trapping location/survey) and standard deviation (SD) between trapping locations of the most common mammal species identified from trapping surveys between 28 July - 5 October 2002 and 2003 at Fort Necessity National Battlefield. Relative abundance and standard deviation of recaptures are provided in parentheses.

Species	RA $\pm$ SD
White-footed mouse	0.41 $\pm$ 0.27 (0.41 $\pm$ 0.33)
Deer mouse	0.07 $\pm$ 0.06 (0.05 $\pm$ 0.08)
Masked shrew	0.05 $\pm$ 0.08 (NA)
Eastern chipmunk	0.04 $\pm$ 0.06 (NA)
Common raccoon	0.02 $\pm$ 0.05 (NA)
Meadow vole	0.01 $\pm$ 0.04 (0.01 $\pm$ 0.03)
Woodland jumping mouse	0.01 $\pm$ 0.03 (NA)
Long-tailed weasel	0.01 $\pm$ 0.03 (NA)
Short-tailed shrew	0.01 $\pm$ 0.02 (NA)

Appendix U. Relative abundance (RA) (average number/survey) and standard deviation (SD) between surveys of the most common mammal species identified from vehicular-road surveys between 28 July - 4 October 2002 and 2003 at Fort Necessity National Battlefield.

Species	RA $\pm$ SD
White-tailed deer	14.1 $\pm$ 7.0
Eastern chipmunk	7.7 $\pm$ 11.2
Red squirrel	0.9 $\pm$ 1.1
Eastern cottontail	0.6 $\pm$ 1.0
Gray squirrel	0.6 $\pm$ 1.0
Woodchuck	0.4 $\pm$ 0.7
Fox squirrel	0.2 $\pm$ 0.5

Appendix V. Relative abundance (RA) (average number/location/survey) and standard deviation (SD) between trapping locations of the most common mammal species identified from trapping surveys between 24 July - 15 October 2002 and 2003 at Friendship Hill National Historic Site. Relative abundance and standard deviation of recaptures are provided in parentheses.

Species	RA $\pm$ SD
White-footed mouse	0.29 $\pm$ 0.25 (0.24 $\pm$ 0.20)
Meadow vole	0.07 $\pm$ 0.12 (NA)
Deer mouse	0.04 $\pm$ 0.05 (0.01 $\pm$ 0.03)
Virginia opossum	0.02 $\pm$ 0.03 (NA)
Eastern chipmunk	0.02 $\pm$ 0.04 (NA)
Common raccoon	0.02 $\pm$ 0.06 (NA)
Short-tailed shrew	0.01 $\pm$ 0.05 (NA)

Appendix W. Relative abundance (RA) (average number/survey) and standard deviation (SD) between surveys of the most common mammal species identified from vehicular-road surveys between 24 July - 14 October 2002 and 2003 at Friendship Hill National Historic Site.

Species	RA ± SD
White-tailed deer	12.8 ± 12.8
Gray squirrel	0.6 ± 0.8
Fox squirrel	0.6 ± 1.0
Eastern chipmunk	0.5 ± 1.1
Woodchuck	0.5 ± 0.8
Eastern cottontail	0.3 ± 0.6
Virginia opossum	0.2 ± 0.4

As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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